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EDITORIAL

FOR A CHANGE

With *everyone* but *everyone* writing about inflation, taxes, budgets, politics, backlogs, good years, bad years, and next years . . . ! ! !

So here is our EDITORIAL - - - and all we want from you is a SMILE.

Sound Familiar?
TO TECHNICAL PAPERS, SAM'S ATTENTION IS SCANT....
HERE'S A MEATY ARTICLE ON ISOTHERMAL HEAT TREATING, SAM! HAVE YOU READ IT?
I SHOULD BE CLUTTERING UP MY GREY-MATTER? I HAVE ENOUGH KNOW-HOW TO SEE ME THROUGH ON THIS JOB!
METAL TREATING
HANK ROESLER
BUT...WHEN OTHERS EXCEL HIM HE'LL RAVE AND HE'LL RANT!
NICE JOB YOU'RE DOING HERE, JOE! YOU SHOW GOOD UNDERSTANDING OF THE FINE POINTS OF THE INDUSTRY. WHERE DID YOU PICK IT UP?
HOW DO YOU LIKE THAT? AND ME WORKING MY FINGERS TO A BONE-HEAD! BY THE WAY, JOE, WHERE DID YOU PUT THAT FILE OF METAL TREATING MAGAZINES?

C. E. Herington

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FURNACES FOR ANNEALING AND DEGASSING OF TITANIUM

By **C. E. PECK,** *Manager*
Commercial Engineering
Westinghouse Electric Corporation
Meadville, Pennsylvania

IN MANY applications, it is necessary to anneal titanium without oxidation; also, it is necessary to remove excess hydrogen from the metal in order to obtain the desired physical properties. Titanium at elevated temperature is an excellent "getter" of oxygen—either in combined form or oxygen as such. For this reason, the conventional protective furnace atmospheres containing CO and CO_2 and H_2O are not suitable. Titanium also reacts with H_2 and N_2 at elevated temperatures; therefore, if these elements are present in the furnace atmosphere, they are undesirable since they cause embrittlement.

If contamination from atmospheres is to be prevented, the only practical ones available are either argon or helium. Since these gases are relatively much more expensive than the more conventional furnace atmospheres, it is not practical to use these gases as protective atmospheres in more conventional furnaces due to large volume rates of make-up atmosphere required.

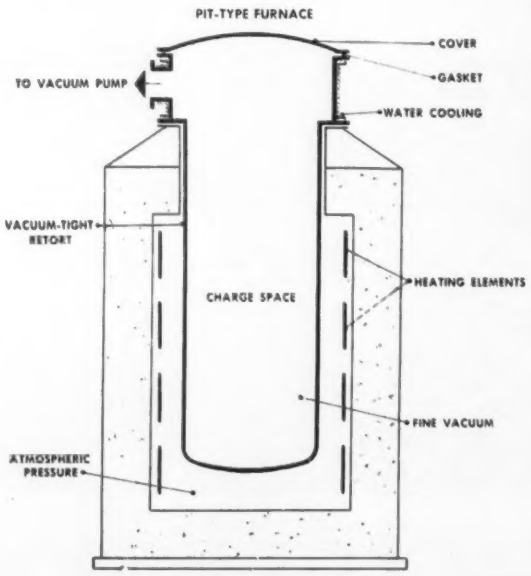

Fig. 1—Schematic view of hot retort pit-type furnace.

For these reasons, those applications of titanium which require high quality of finish and the best in physical properties require equipment capable of heating the titanium in a high vacuum. This requires furnace design considerations different from those required for controlled atmosphere furnaces.

Up to the present time, the furnaces have been of batch type rather than continuous due to problems of designing seals for vacuum tightness with continuously moving work. Batch-type furnaces consist of box, pit, bell, and horizontal in and out furnaces such as roller-rail and car-type.

The more conventional vacuum furnace designs consist essentially of a metal heat-resisting alloy retort which is evacuated and which contains the work to be heat treated.

The retorts are usually cylindrical in shape in order to minimize thermal stresses. Also, they are supported in a vertical position either from the top as in a pit-type furnace, or from the bottom as in a bell-type furnace. This method of support permits the use of relatively large diameter retorts (Fig. 1).

Small diameter retorts are also mounted in a horizontal direction where problems of support, thermal expansion and vacuum seals are not very difficult to solve.

In all cases, the retort is placed in an electrically heated furnace using electric resistors as the means of heating. A large resistor-type electric furnace rated at 520 kw is capable of holding an alloy-metal retort 6 feet in diameter and a charge space 17½ feet high.

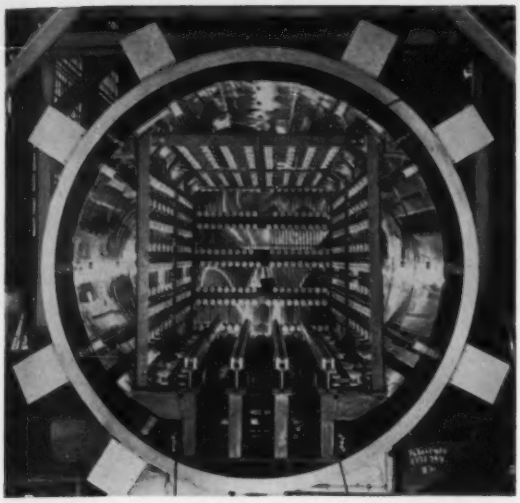

Fig. 2—Kold-Retort® furnace installed at the Mallory-Sharon Titanium Corporation for combination annealing and hydrogen degassing of titanium sheet and also rod and bar stock.

In order to insure longer retort life with a minimum of creep and distortion, a vacuum is pumped in the furnace chamber between the outside of the retort and the furnace chamber itself in addition to the vacuum pumped on the inside of the retort or work chamber. However, the vacuum outside the retort need not be as great as on the inside since the equalizing of pressures is the important factor rather than absence of impurities such as that required in the work chamber. For this reason, the furnace chamber must be made vacuum tight as well as the retort.

At lower temperatures (up to 1600 degrees F) such as that required in the annealing of titanium and its alloys, this type of design gives reasonably good retort life. This is necessary since these large retorts are heavy and very costly. For higher temperatures, the life of metal retorts is much more limited and they present a maintenance and replacement problem, particularly in the larger size ranges.

Another type of vacuum furnace design eliminates the need for a hot retort by using an outer steel shell designed for vacuum tightness as the retort, and placing within the shell a series of radiation shields which take the place of the brick work and insulation of a more conventional furnace design. This so-called "Kold-Retort" furnace is particularly adaptable for use at high temperatures for heat treatment and brazing of stainless steels.

However, this design has also been found to be quite practical and useful for vacuum degassing and annealing of the refractory metals, such as titanium in the lower temperature ranges, particularly where it is desirable to handle the material in a horizontal direction and where larger furnaces with high production rates are required.

A representative design of this type with a charge space 4 feet wide, 4 feet high, and 12 feet long was designed for and in cooperation with the process engineers of the Mallory-Sharon Titanium Corporation for combination annealing and hydrogen degassing of titanium sheet and also rod and bar stock (Fig. 2).

The furnace is rated at 450 kw and can handle up to 10,000-pound charges. Total cycles are one-half to one-third that required in large hot retort types; hence, the production per furnace hour is much higher. The basic reasons for this are the fast heating and degassing made possible by using a design with relatively low heat storage in the furnace. The same holds true for the cooling cycle which can be further reduced by introducing argon or helium and recirculating with a fan.

This type of furnace has proven to be very efficient for annealing and degassing. Several tons of sheets of various sizes and gauges can be annealed and degassed with hydrogen contents averaging under 50 to 60 parts per million. This low hydrogen content allows a comfortable margin for further processing without exceeding values of hydrogen which can result in loss of desirable mechanical properties.

The furnace can be evacuated to one millionth of an atmosphere and pumping capacities are sufficient to remove gases at a low enough pressure to be well below the equilibrium solubility of hydrogen in titanium under high vacuum conditions.

Since loading can be done horizontally, charges can be prepared on loading racks external to the furnace and charged into the furnace on the charging car immediately following the discharge of another load. This allows continuous use of the furnace for production purposes and eliminates any long pump down or "conditioning" of the furnace.

Also, since loading can be done horizontally, the furnace can anneal several tons of bar stock or rod and remove hydrogen at the same time. The bars may be laid in a horizontal plane for ease of handling.

Summarizing—in the field of annealing and degassing titanium, the hot retort furnace is suitable for smaller production rates on relatively small size and shape of parts. For high production rates and for large size sheets or large length of bars, etc., the "Kold-Retort" design is more suitable since it eliminates large expensive hot alloy retorts, allows much faster cycles and simpler material handling methods.

Vacuum annealing and degassing removes hydrogen to very low values and makes possible the use of titanium and its alloys at elevated temperatures without possible failure due to brittleness under slow creep rates.

Removal of hydrogen also allows the maximum in notch bend impact strength and maximum tensile strength at elevated temperatures. Furnace designs are commercially available which will achieve these results. ■ ■ ■

OPERATING COSTS CUT USING FABRICATED TRAYS

By **PETER R. D'ENGENIS,** *Heat Treating Engineer,*
The Fenn Manufacturing Co.,
Newington, Connecticut

THE Fenn Manufacturing Co., has cut operating costs approximately 20% by using fabricated trays made of Inconel* nickel-chromium alloy in place of cast trays made of other heat-resisting type alloys. The company manufactures metal forming equipment, such as rolling mills and swages, in addition to aircraft components and helicopter rotor heads and transmissions. Inconel trays, manufactured and designed by Wiretex Manufacturing Co., Bridgeport, Conn., are being used as stacking pit furnace baskets for a 20" x 24" atmosphered pit furnace.

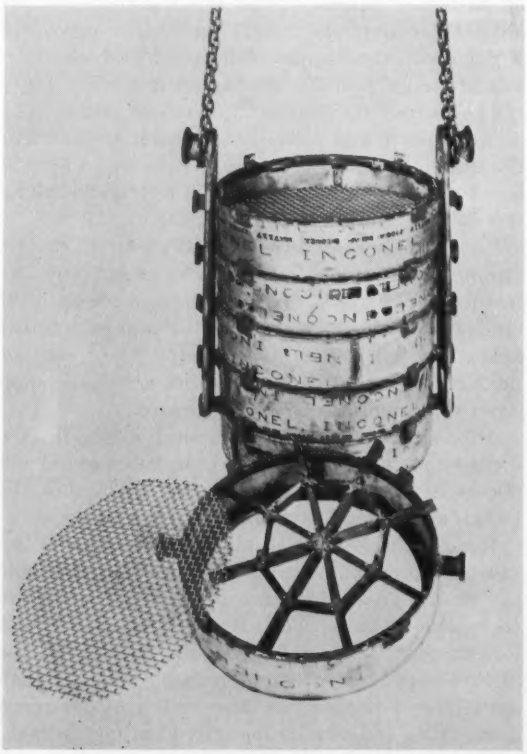

Fig. 1—Inconel tray designed and manufactured by Wiretex Manufacturing Co., now in use at Fenn Manufacturing Co. as stacking pit furnace baskets for a 20" x 24" atmosphered pit furnace.

Wiretex engineers recommended Inconel after thorough testing because of its facility to withstand high temperature corrosion. Inconel was found most effective when used in the range 1500°F. to 2150°F. in sulphur-free atmospheres. At these higher temperatures it was found Inconel offers the greatest strength and endurance of the standardized heat-resisting alloys. It was found that heating time was cut approximately 25% with the new fabricated trays, which are approximately 25% lighter than the casted trays that were formerly used.

Although Inconel is used to advantage in the fabrication of furnace parts, structurals, and other fixtures where load carrying capacities are heavy, Wiretex found it perfect for heat treating trays and fixtures where the material is subjected to repeated heating and cooling cycles, involving quenching. Strength requirements were met, yet great savings resulted in weight and material. The combination of high strength and low expansion withstood the thermal stresses that were set up; in many cases these stresses were many times the actual physical load. Little or no warpage was found in spite of the work loads of 150 lbs. per basket, or 700 lbs. per load. At the same

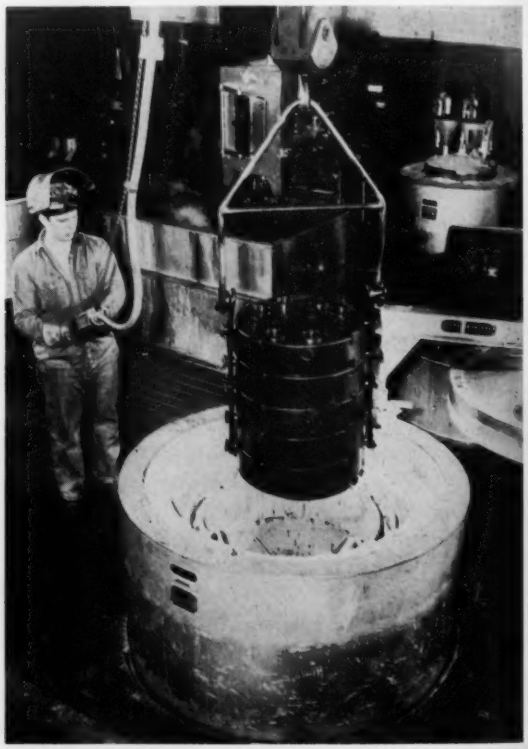

Fig. 2—Inconel trays in use as furnace is unloaded for batch-type quenching.

* *Reg. Trade Mark of International Nickel Co.*

Fig. 3—Furnace load is quenched in oil.

time the work load capacity increased over 30%. Moreover, adding to the versatility of the baskets, they were found to be practical for use in carburizing parts, for direct quenching in water or oil, as tempering trays, and for holding parts in the deep freeze unit. Temperature range is from 120°F. below zero to 1825°F.

In designing and constructing baskets for such operations, Wiretex engineers found that the successful solution to the majority of the heat-resisting problems was dependent upon the recognition of the properties required, the selection of the alloy, and the design which best fulfills these requirements. Users of high-temperature equipment measure the performance of an alloy in terms of cost per hour of service. The combination of good design, fabrication and material which yields the lowest cost per hour is generally proved most satisfactory . . . and the most economical.

Studies proved that Inconel offered excellent resistance to thermal shock, such as encountered in oil quenching from temperatures above 1500°F., and also had great strength for load-carrying capacity. The alloy also possesses good resistance to carburization and excellent resistance to nitriding through the temperature range usually encountered, as well as oxidation resistance up to 2100°F.

The Fenn Stacking Pit Furnace Fixtures consist of a lifting fixture and five stacking-type baskets. The baskets are fabricated of solid plate sides with a heavy wire mesh screen resting on a removable grid bottom. The fixtures are constructed to carry five baskets or more depending upon the depth of the furnaces.

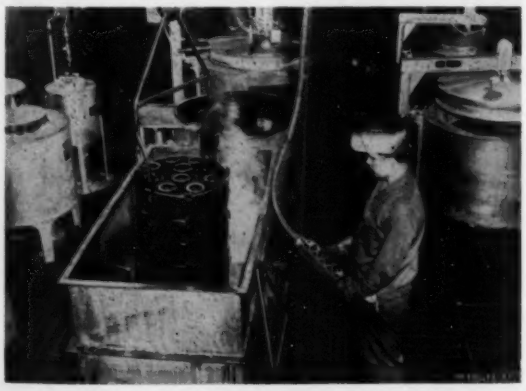

Fig. 4—Load is washed prior to tempering.

Fig. 5—Load is lowered into furnace for tempering using light-weight fabricated trays. The trays are not unloaded until any required sandblast or deep freeze operation is completed. Wiretex's Retort Work Basket (with handles) and Homo Carb type basket are shown in use.

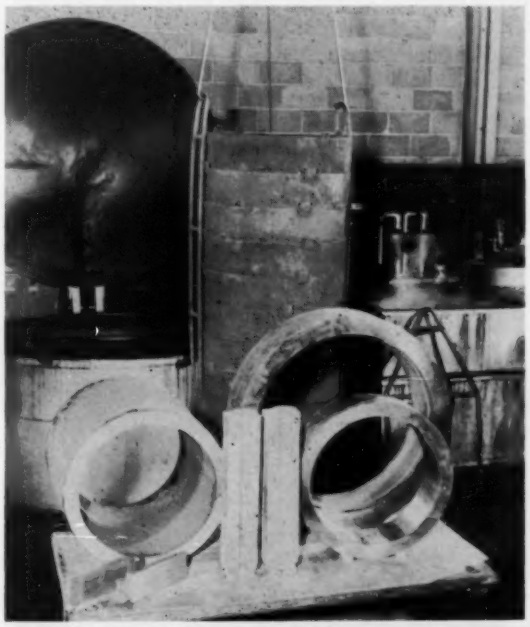

Fig. 6—Head rings, wedges and dies used on different type swaging machines have all been heat treated in baskets made of Inconel and designed by Wiretex.

Upkeep of these baskets is low, and repairs can be made very easily. They had been in use for over 2,000 hours when this survey was made, and little or no wear was observed. ■■■

ANNEALING OF ZINC BASE DIE CASTINGS

By **W. B. Stephenson, Jr.,** *Chemical Process Engineer*
Flight Propulsion Laboratory Department
Aircraft Gas Turbine Division
General Electric Company
Cincinnati, Ohio

EVER since one of our hairy ancestors accidently dropped his gold amulet into the family cooking fire, mankind has been striving, with heat, to change the condition or properties of various metals. For centuries heat treatment procedures and alloy contents were grimly held secrets passed from father to son and revealed not unto the point of death. Methods, perforce, were empirical and results erratic, but early heat treaters were dauntless and inquisitive. What a picture we have today. The heat treater has at his disposal huge stacks of heat treat formulae, the most precise of instruments, and ingenious of quenching mechanisms. However, in many cases we have become too content to go "by the book" and refuse to experiment.

Zinc, particularly zinc base die casting, is not generally considered a heat treatable metal. But the heat treating of zinc base die castings can sometimes be of great assistance to the electroplater. Die casting, by its nature, chills the surface of the casting resulting in a "skin" of fine dendritic grain structure. The cooler the die surface (within practical die casting limits) the smaller the grain size and the harder the surface of the die casting. Conversely, the farther from the die surface, the larger the grain size and usually the more porous the metal. For most finishing purposes, such as buffing and electroplating or lacquering it is advantageous not to cut through the "skin" into the more porous metal. However, quite often there are blemishes in the skin itself. These lead to finishing troubles of varying magnitudes.

Several of the more troublesome blemishes are listed below.

Run Pattern

This condition probably exists in the die castings 100 per cent of the time and is nothing more than the flow pattern left by the metal on the instant of solidification. Most of the time this pattern is not discernible on the surface of a raw die casting or a buffed one. Occasionally, for reasons unknown, but possibly due to the orientation of the zinc crystal structure, this pattern may be seen after the part has been buffed and electroplated.

Cold Shot

This is sometimes called "cold shut" and is caused by two or more converging streams of metal which have become a little too cool to completely mix and so solidify, leaving a typical curlycue pattern which is more or less porous at the touching faces of the streams. This porosity often becomes a void during polishing and buffing and causes blisters, roughness, and pits in the electroplate.

Solder Spots

These are usually caused by small droplets of metal

(Continued on page 44)

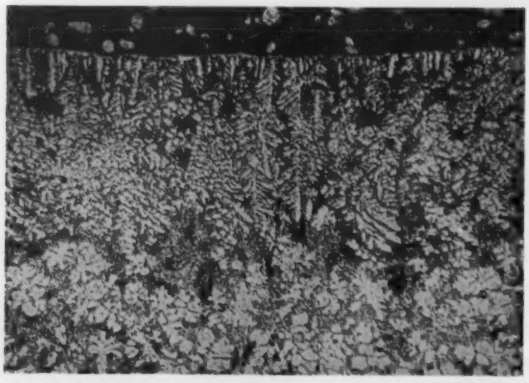

Fig. 1—Photomicrograph (mag. 500x) of an as-cast zinc die casting. The pronounced dendritic structure at the surface is easily seen.

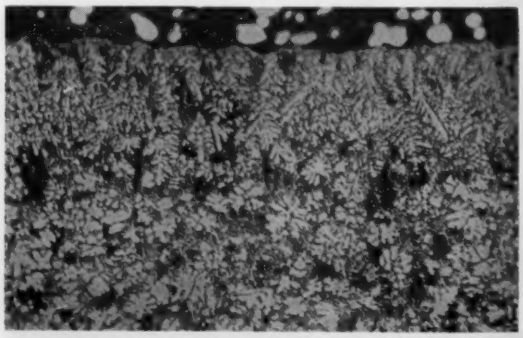

Fig. 2—Micrograph (mag. 500x) of the adjacent section to that shown in Fig. 1 after being heat treated one hour at 410°F. and air cooled. The dendritic structure has broken up.

(Photos courtesy General Electric Company, AGT Materials Laboratory)

This Recuperative Atmosphere Rotary Scale-Free Heating Furnace, manufactured by The Lithium Company, Newark, N. J., employs Norton segmented conduits — *engineered and prescribed* CRYSTOLON tongue and groove tiles. Other Norton refractory shapes in the furnace are ALUNDUM burner blocks — equally efficient in aiding Lithium's recognized advancement in many heating operations.

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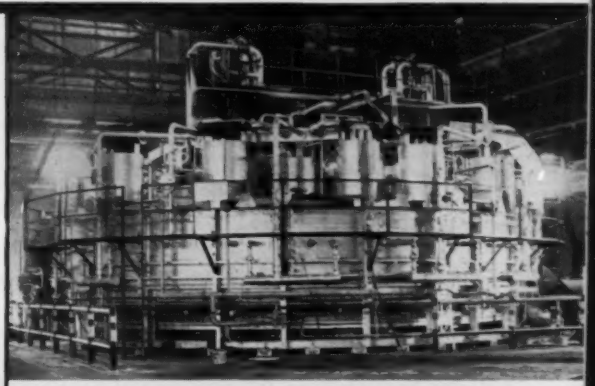
*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



One of a group of Recuperative Rotary Forging Furnaces installed by Lithium Company in a leading automotive plant for the production of *scale-free heated* billets to temperatures of 2400°F.

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STEEL GRIT ABRASIVE ADVANTAGEOUS IN BLAST CLEANING HEAT TREATED PARTS

By **Eugene F. Anderson**, *Special Engineer*
Wheelabrator Corporation, Mishawaka, Ind.

RECENT tests conducted to determine the most desirable abrasive for blast cleaning heat treated parts showed steel grit preferable. The tests were conducted by Commercial Steel Treating Corp., Detroit, Mich. Results indicated that steel grit abrasive reduced equipment maintenance, reduced abrasive consumption, and made possible faster cleaning.

Fig. 1—A view at Commercial Steel Treating Corp. showing a table-type blast cleaner at the left; a five cubic foot capacity tumble-blast cleaner in the center; and a two cubic foot tumble-blast cleaner at the extreme right. *(Courtesy of Wheelabrator Corp.)*

Commercial Steel Treating Corp. is a large commercial heat treating plant offering a complete range of services. These include oil, air, and water hardening; oil, air, and salt-bath tempering; bright, surface, and case hardening; carburizing; annealing, normalizing, and stress relieving; Gleason machine quenching; straightening; and blast cleaning.

Somewhere around 75 to 80% of the work heat treated is blast cleaned also. This makes it necessary for Commercial Steel to use several pieces of blast cleaning equipment. Among them are five airless abrasive blasting machines. All five have automatic characteristics of operation. The variety of work that needs to be cleaned dictates the use of both batch-type tumble-blast machines and rotary-table-type blasters, three of the former and two of the latter. All use grit as the abrasive, to provide the finishes required by the customers.

The tumble-blast machines are Wheelabrator Corporation Tumblasts. Two have capacity to accommodate five-cubic-foot loads of work; the third has a load capacity of two cubic feet. This makes it possible for each to accommodate hundreds of small parts or scores of medium-sized parts or several larger parts at a time, to achieve mass-production cleaning. They operate almost completely automatically, with the operator's attention not needed during the actual blasting operation. Each has an endless belt conveyor inside the blast chamber. This continuously tumbles the parts under the blast of abrasive thrown centrifugally from a rotating wheel in the blast chamber roof. Tumbling assures that all areas get uniform blast. The operator is needed only for loading the machine and for starting and stopping the blast cycle by push-button control. Automatic unloading is also done by push-button control.

Both table-type airless blast cleaners have eight 28" diameter work tables mounted on a spider. The spider rotates and carries the individual tables in and out of the blast. Complete blast coverage on all areas of all parts is achieved in this case by the rotation of the individual tables themselves. The same operator loads the work tables as they enter the blast and

(Continued on page 42)

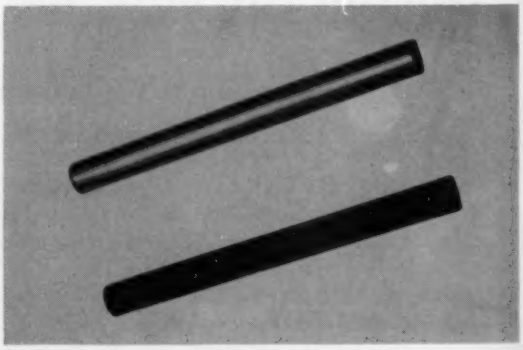
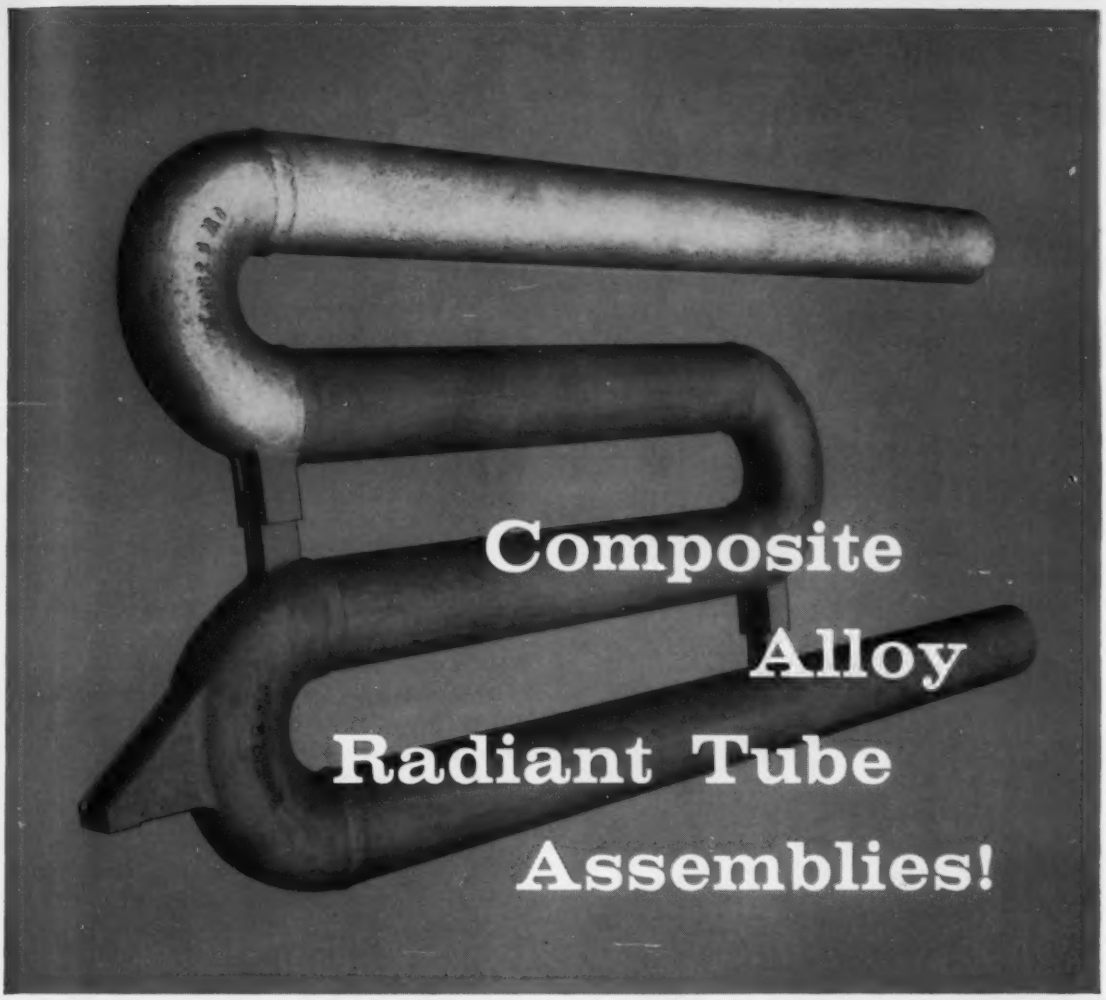


Fig. 2—A typical part handled in a five cubic foot tumble-blast cleaner. These are shafts of oil-hardening tool steel, are heat treated and tempered before blasting, and are shown in conditions before and after blast cleaning. *(Courtesy of Wheelabrator Corp.)*



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Right Or Wrong In

LABOR RELATIONS

Editor's Note: *This department presents, in each issue, a round-up of day-to-day in-plant problems and how they were handled by management. Each incident is taken from a true-life grievance which went to arbitration. Sources of these cases will be given upon request.*

Must an Employee Wait for a Merit Increase After His Work Has Improved?

What Happened:

There was a merit increase plan for salaried clerical employees at a large industrial plant. Under the plan, two automatic raises were given to the employee within the first year. After that, his progress to the top rate range depended strictly on merit. Provided that its judgment was not "arbitrary or capricious," management made the decision about an employee's merit.

Bill Rosser felt he was not getting a fair shake because he had received no merit increases. So he filed a grievance. While the grievance was pending, his work improved in a great degree, and after about 16 months he was raised to the top of his range.

But this did not settle the matter. Rosser felt he should have received the increase much earlier. It was admitted by both sides that the improvement in his work had developed about nine months before he got the raise.

Was the Employee: RIGHT ☐ WRONG ☐

What Arbitrator Ralph T. Seward Ruled:

"The evidence does not convince the Arbitrator that the denial of Rosser's initial request for an increase was the result of a 'freeze' on merit increases instituted by management, or, that it was motivated by any reasons other than supervision's opinion that he did not then deserve to be raised to the top of the range.

"From the evidence presented, the Arbitrator believes that the opinion was reasonable and that there was no contract violation to Rosser at that time. On the other hand, the Arbitrator cannot uphold management's delaying the increase as long as it did. Management concedes that Rosser's performance improved sharply nine months before his raise was granted, and continued at the improved level thereafter. Though the company was entitled to wait a reasonable time to make sure that the improvement would be lasting, the Arbitrator cannot hold that a nine-month delay was reasonable or justified. Rosser shall be paid for the salary lost for six months."

Can You Discipline a Worker Who Refuses to Listen to His Foreman?

What Happened:

The foreman saw Harry Ross slip a couple of small parts out of a bin into his pocket. "What do you think you're doing?" the foreman called out to Ross. Ross slipped the parts out of his pocket back into the bin as he answered, "Nothing!" and started to walk away. "Hey, you, I wanta talk to you about this," the foreman shouted, but Ross kept on walking away.

When Ross went to punch out, the foreman was

waiting for him at the time clock. "We'll talk about this tomorrow," the foreman said. At this point, Ross had a change of heart and insisted that it be discussed immediately. "Tomorrow!" insisted the foreman. Ross's language got real rough at this point. The next day, the foreman fired Ross, who appealed—and the case went to arbitration. Ross argued:

1. He had not been accused of stealing or rule-breaking.
2. Anybody would keep going if the foreman yelled "Hey, you" at him.
3. Even if he had been wrong to walk off when his boss wanted to talk to him, getting fired was too tough a penalty.

The foreman's position was:

1. It was reasonable for him to want to talk to Harry Ross about what looked like theft.
2. There's nothing insulting about calling "Hey, you" to a worker who's walking away from you.
3. Harry's attitude and remarks at the time clock, added to the rest of it, made the matter serious enough to fire him.

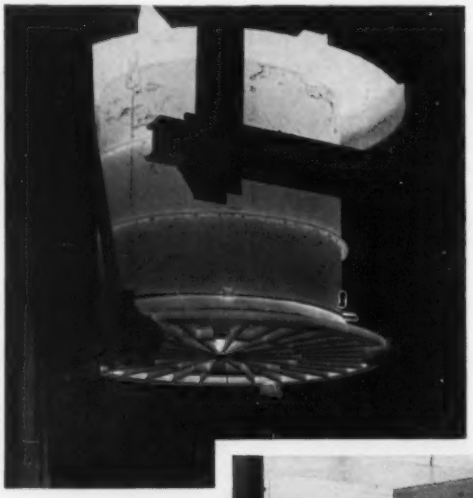
Was the Foreman: RIGHT ☐ WRONG ☐

What Arbitrator Carl Warns Ruled: "If the foreman believed that a discussion and further explanations of the working rule against the taking of goods was desirable, it was a part of the job of Mr. Ross to listen. Walking away from the foreman in the presence of other employees while an attempt is being made to explain a difference of opinion, may be just as destructive of necessary respect for supervision and just as destructive of effective teamwork as a refusal to carry out a production order.

"The further conversation at the time clock in which Mr. Ross insisted that the differences be discussed immediately places him in a position where I sincerely believe that a reversal would amount to a substitution of my judgment for the company's under circumstances where their determination was reasonably clear. Facts support the charge of insubordination. The company's decision must stand." ■ ■ ■

"...need dry gas for your atmosphere furnace?"

REAL DRY GAS?



In an installation at Solar Aircraft Co., this small AIR-DRY dehydrator purifies all of the protecting and reducing atmosphere for the huge elevator type furnace shown above.

In conjunction with the above installation Solar Aircraft Co. has stated, *"We consider these drying units vital to the purification of hydrogen, used as a protective, reducing atmosphere in our production brazing process . . ."*

Not merely gas purification but *HIGH DEGREE* purification is the aim of our Engineering and Manufacturing Divisions. Laboratory precision combined with industrial ruggedness make AIR-DRY equipment the natural choice where dehydration or decontamination of *any* atmosphere is needed.

Whether your need is for fully automatic or for semi-automatic operation, AIR-DRY can produce a unit to comply with your specifications, *however exacting they may be.*

A-A

High or Low Pressure PURIFICATION and DEHYDRATION EQUIPMENT for all gases

AIR-DRY CORPORATION OF AMERICA

14756 KESWICK STREET, VAN NUYS, CALIFORNIA

ABSTRACTS

New Nitriding Process Uses Glow Discharge

By P. M. Unterweiser

(The Iron Age, May, 1957)

Glow discharge nitriding is a brand new process for surface hardening. It has already been successfully applied to a variety of low-alloy steels as well as a few stainless grades. In common with conventional nitriding, it makes use of a nascent nitrogen atmosphere. But that's where similarity ends and major differences begin. Most different is the way in which the parts to be nitrided are heated. There is no conventional furnace equipment involved. "Ionitriding"—as it is called—makes use of an almost loss-free conversion of electrical energy into gas-ion energy and heat. The conversion is achieved by electrical glow discharge. Each part is made to carry a cathodic electrical potential. And each part heats individually to an optimum "control" temperature for nitriding.

Developed by European industrialist Bernard Berghaus, the new process has already stirred wide interest in both Germany and Switzerland. As is the case with many new processes, the results so far achieved by ionitriding are strictly preliminary. Quite a few pertinent problems—both commercial and technical—still remain to be solved. In spite of tentative claims, the process appears to have a strong industrial potential. Such eminent scientists as Prof. Walter Weizel (head of Bonn University's Institute of Physics) and Dr. Adolph Fry (former research director of Krupp) are now devoting their full time to its further development.

How does ionitriding work? Parts to be nitrided are placed in an air-tight, metal cylinder. Each part is previously placed in contact with its own individual electrode. Then the container is sealed and evacuated.

In place of the evacuated air, nitrogen and hydrogen are bled into the container. High-current energy is fed to the parts via the individual electrodes. This current both heats the parts and produces glow discharge. Simultaneously, the gaseous atmosphere is ionized. Atomic nitrogen is accelerated towards the energized surfaces of the parts. At this point, diffusion of nitrogen into the surface begins. It continues at about the same level of activity for as long a period as is required to produce an adequate nitrided case depth.

These, essentially, are the elements of operation. Many of the details are technically complex and defy simple explanation. Nitriding occurs at 932°F. This temperature is maintained within close limits throughout the entire cycle. (A 24½-hour cycle was used in preliminary tests.)

The container in which the parts are enclosed carries an anodic potential, the work being cathode. The container never heats directly, nor does it heat appreciably. The only heat to which it is exposed stems from radition losses given up by heated parts.

According to Berghaus, the nitrogen atoms actually bombard the metal surfaces to which they are attracted during glow discharge. Consequently minute particles of metal are removed from the surface of parts during initial stages of nitriding. The total amount of metal removed by this action is insignificant. It is not large enough to affect tolerances.

Among the advantages claimed for ionitriding are:

(1) It makes efficient use of high-current discharge for the first time.

(2) It is faster than conventional nitriding.

(3) It provides a more ductile, more fatigue-resistant nitrided case.

(4) It produces less "white nitride" than conventional techniques.

(5) It conserves power by heating the parts rather than an entire furnace.

For the most part, these are tentative claims based entirely upon preliminary tests. The purely economic aspects of ionitriding have not as yet been conclusively determined. It is assumed that processing costs will not be prohibitive.

The ultimate success of ionitriding depends primarily upon the metallurgical results it can produce.

At present, there is no fatigue test data available for ionitrided specimens. Such information is now being gathered in Europe and should be made available within the next year.

Nitriding Stainless Steels Costs Less in a Salt Bath

By H. A. Johnson, Boeing Airplane Co.

(Materials & Methods, November 1956)

Stainless steel can be nitrided in a salt bath at lower cost than in the conventional gas nitriding furnace. Although the case is only half as thick as that produced by gas nitriding in equivalent time, the surface reaches a hardness of Vickers 1355 and is resistant to oxidation up to 600°F.

The salt bath can be used to nitride both chromium and chromium-nickel stainless steels. Among the stainless steels successfully treated by this method are AISI 321 and 440C, AM 350 and 17-7 PH. The heat resisting chromium-nickel alloy A-286 has also been salt bath nitrided.

Parts are nitrided at 975° to 1050°F, case depth depending on treatment time. Case depths obtained on the various stainless steels in a given time period are quite similar. For example, after 24 hours at 975°F, the depths range from 0.0015 in. for AISI 321 to 0.0019 in. for AISI 440C. In contrast, under the same conditions case depth on Nitralloy 135, Modified, is 0.0062 in.

(Continued on page 43)

"PARK-KASE GIVES US TOP QUALITY CRAWLER TRACTOR PARTS... CUTS HEAT TREAT COSTS 50%"

William J. Blazek, President, Evans Reamer and Machine Company, a manufacturing division of Lempco Automotive, Inc., Cleveland, says, "QUALITY must be the watchword around here because Lempco's replacement parts go into practically every type and make of crawler tractor. These parts have got to be good to meet the challenging requirements of this great tractor industry.

"On track bushings, for example, correct heat treatment is essential to the quality of the product—and costs must be in line.

"After a great deal of investigation, we decided that the high quality of Lempco's bushing could best be achieved effectively through the use of salt bath heat treatment. We selected Park-Kase No. 2 Energizer for the salt bath operation. It has never let us down.

"More than 19 different-sized track bushings—all with different wall thicknesses—all made from low carbon steel—are carburized at 1750 deg. F. in Park-Kase. There is also the economy of a direct quench in an 8% brine solution maintained at 70 deg. F. by refrigeration. Bushings are fully case-hardened to the required accepted standards. Case depths up to 0.110 in., depending upon wall thicknesses involved, are readily obtained in our salt bath heat treatment.

"We have achieved the top quality in these replacement parts that we must have. We have done this at a saving in cost of 50% over the previous heat treat methods. In fact, salt consumption and costs are lower than even the pre-installation estimates.

"To make a long story short, we must have quality and economy in this operation. Park Chemical Company more than satisfies our requirements."

For complete data on Park-Kase No. 2 Energizer write for technical bulletin A-1. Park Chemical produces a complete line of heat treating materials and would be happy to help you work out a solution to your heat treating problems without obligation. Call or write today.

Evans Reamer and Machine Company uses Park-Kase Energizer #2 to case-harden track bushings up to 0.110" case depth. Inspecting track bushings that have been case hardened are (l. to r.): from Evans: Lynn M. Leslie, Production Manager; LeRoy L. Johnson, Superintendent; William J. Blazek, President; from Park Chemical's Cincinnati Office, James F. Hetz.

Park

Woodside Rapid Carburizers (Non-Burning—Charcoal–Coke–Specification) ● Park-Kase Liquid Carburizers ● Quenching and Tempering Oils ● Cyanide Mixtures ● Neutral Salt Baths ● High Speed Steel Hardening Salts ● Iso-Thermal Quenching and Tempering Salts ● Protective Coatings (No-Carb—No-Kase—No-Scale—No-Tride) ● Carbon Products (Charcoal—Crushed Coke-Pitch Coke–Lead Pot Carbon) ● Kold Grip Polishing Wheel Cement ● Par-Kem Metal Cleaners ● Cutting and Grinding Compounds (Kem-Cut—Kem-Grind—Blue Ice)

PARK CHEMICAL COMPANY 8074 Military Ave. • Detroit 4, Mich.

HEAT TREATING HINTS

QUENCHING — *The Doorway to the Hardening Reaction*

In the two preceding issues this column discussed the preheating and austenitizing steps of the heat treating cycle. In this issue we will discuss the quenching phase of heat treatment. Quenching may be defined as the controlled cooling operation which allows the steel to harden. While the austenitizing treatment determines the exact hardness that will be obtained, the quenching cycle is the step that permits the steel to attain that hardness.

Quenching is also a time-temperature dependent reaction, with equal emphasis placed on both of these factors. In cooling from the austenitizing temperature, the steel must pass fairly rapidly through the critical range (approximately 1300-1100°F.) in order to insure that the hardening reaction will take place. The minimum rate at which the steel must be cooled to develop full hardness can be termed the critical quenching velocity, and is controlled basically by the analysis of the steel and the austenitizing treatment. This critical quenching velocity is quite rapid for low alloy steels but is much slower for steels containing appreciable amounts of hardenability agents, such as molybdenum, nickel, chromium, and manganese. Steels therefore are commonly classified according to their required quenching velocity, i. e., water, oil, or air hardening varieties.

Getting the steel successfully through this critical range of 1300-1100°F. is one of the major hurdles in the quenching cycle, but at this point the steel has only promised to harden. Now the reaction becomes more dependent on temperature rather than time, and actual hardening does not begin until a much lower temperature is reached. The temperature at which hardening begins to take place is below 600°F. for most tool steels. The length of time that the steel can be held in the twilight range of 1100°F. to 600°F. depends upon its composition. The existence of this twilight temperature range permits the use of special quenching techniques such as slack quenching, martempering, and salt and lead bath quenching. These techniques employ an equalization of temperature before initiating the actual hardening reaction. The final stage of quenching is then carried out at a less drastic rate, resulting in more uniform cooling and lower quenching stresses.

The hardening which occurs in the latter stages of the quench is a volumetric reaction with the relatively soft austenite changing to a harder and more volumi-

(Continued on page 43)

Bata cuts mold cleaning time in half with Pangborn Hydro-Finish

Bata Shoe Co., Belcamp, Md., used to clean shoe molds by pickling. For a better cleaning job, Bata replaced this process a year ago with Pangborn Hydro-Finish. Today this machine gives Bata top quality cleaning, does the job *in half the time* required by pickling and has required "no maintenance whatsoever." Also, acid disposal problems have been eliminated.

Says Mr. Albert Kotras, Research, "We thought it was sales talk but the Hydro-Finish has lived up to every claim the Pangborn representative made." Convinced by the performance of its Hydro-Finish machine, Bata management now plans to order a second one.

Today, through new design and use of air jet sluriators, Pangborn Hydro-Finish costs less originally, costs less to maintain and gives you easier handling and added efficiency. Write for Bulletin 1403 to PANGBORN CORP., 3600 Pangborn Blvd., Hagerstown, Md. *Mfrs. of Blast Cleaning and Dust Control Equipment.*

USE PANGBORN HYDRO-FINISH FOR:

Deburring • Surface finishing • Finishing threaded sections • Improving cutting tool life • Maintaining dies and molds • Removing grinding lines • Removing heat treat scale • Preparing surfaces for coatings, platings, etc.

Pangborn

BLAST CLEANS CHEAPER

Brings more uniformity to heat-treating

MORE uniform quench

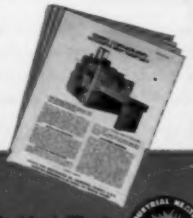
MORE uniform heat

MORE uniform case depth

All these "plusses" are yours with the new Eclipse Clean-Line furnace because: (1) atmosphere and temperature are distributed with complete uniformity during heating — there's no stratification — and (2) even tightly packed loads of the smallest parts are quenched uniformly in the oil jet-agitated tank served by the high-capacity pump. The Clean-Line furnace, rated to heat-treat 400 lb of work in one hour, and with quench capacity for 700 lb per load, is designed for fully automatic clean hardening, carbonitriding, carburizing, carbon restoring, or annealing. Standard Clean-Line furnaces are designed for operation at temperatures up to 1850° F.

Complete control of all heat-treat operations is right at your fingertips. You can select an air or oil quench, for example, just by flicking a switch on the control panel. Heating cycle, high oil pump circulation, and quenching cycle for a particular workpiece can all be controlled precisely and automatically by three separate timers on the control panel. All these features add up to better quality — every piece in every batch.

WRITE for bulletin and data sheets describing the Clean-Line system that includes endothermic generators, automatic washers, and tempering units.



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IHEA

THE APPRENTICE CORNER

SURFACE HARDENING PRACTICES

By E. J. PAVESIC, *Director of Research*
Lindberg Steel Treating Company
Melrose Park, Illinois

Definition

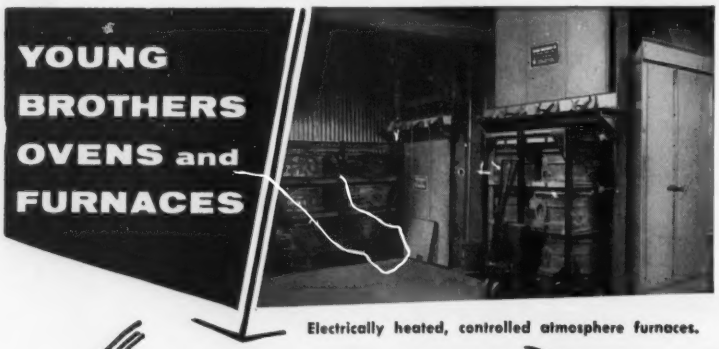
Surface hardening is a method or process of heat treatment whereby the surface hardness of a part is increased substantially over that of the inner portion normally termed the core. It is applicable to a wide variety of hardenable ferrous alloys and gray and pearlitic malleable cast irons.

Reasons for Surface Hardening

The principal purpose of surface hardening is to increase the hardness at the surface to a more useful level without sacrificing other essential mechanical properties that may be required of a given part. More specifically, a high surface hardness may be required of a part to resist wear and to sustain high unit loads encountered in a variety of services. If a given part were to be made of a material capable of providing the requisite wear resistance and load carrying capacity at the surface and these properties prevailed throughout the entire part its usefulness might be reduced or destroyed because of the attendant brittleness. Surface hardening then implies that there are at least two distinct zones within a part so processed. Each zone will have a different hardness and other mechanical properties, e.g. yield strength, tensile strength, reduction of area and elongation, the latter two properties being criteria of ductility.

It is a generally accepted fact that increasing the hardness of a given material will increase its resistance to wear and deformation. The hardness attainable in ferrous alloys is governed by their carbon content. For example, a steel containing 0.10% carbon can be hardened to Rockwell "C" 40, while steels containing 0.20%, 0.40% and 0.60% carbon can be hardened to values of Rockwell "C" 49, 60 and 65 respectively. Increasing the carbon content of a steel beyond 0.60% does not result in a commensurate increase in hardness. For example, a 1.00% carbon steel will attain a hardness of about Rockwell "C" 68 and from a commercial standpoint this is the highest hardness practicable of attainment on steels and cast irons. These hardness maxima are dependent on quench hardening to a microstructure which is essentially 100% martensitic (fully hardened). It is not intended to imply that wear resistance is a function or is affected solely by hardness (and carbon content). The addition of alloying elements such as chromium, molybdenum, tungsten and vanadium which combine readily with carbon to form extremely hard carbides increase resistance to wear. The combination of chromium and molybdenum with aluminum forms the basis of an alloy which when subjected to the action of nitrogen at elevated temperatures attains extreme hardness and resistance to wear.

(Continued on page 19)



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HEAT TREATING

Young Brothers Ovens and Furnaces are the product of 60 years of experience in building ovens and furnaces for all heat treating processes. As a result they operate more efficiently, turn out more and better production and meet the exact requirements for which they are engineered.

Knowing the basic problems of heat treating, Young Brothers Engineers have perfected ovens and furnaces that operate reliably, provide large savings in fuel and handle a wide variety of work requiring a broad range of temperatures and heating cycles.

For better heat treating results in less time, at lower cost, investigate the exclusive advantages that Young Brothers Ovens and Furnaces offer. Write for Bulletin 157.

YOUNG BROTHERS COMPANY
1849 Columbus Road Cleveland 13, Ohio

Tool Steel Topics

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

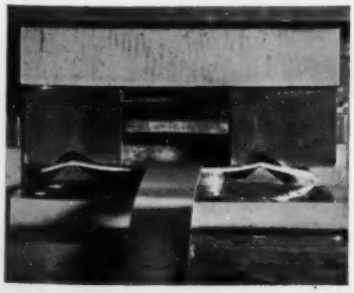
BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

Export Distributor: Bethlehem Steel Export Corporation

Maker of Beer-Can Openers Likes Economy of Lehigh H

Precision Manufacturing Company, San Antonio, Texas, needed a tool steel to produce a strong, long-wearing die with which one of their customers could economically manufacture beer-can openers. They put the problem up to their local tool-steel distributor, Earle M. Jorgensen Co., who recommended Bethlehem Lehigh H. "Our experience with this air-hardening grade has shown us how it stands up," the Jorgensen people said. "It's resistant to wear and, besides, has low distortion in heat-treatment."

The die was heat-treated by Cook Heat Treating Company, Houston, Texas. It was placed in service in a 56-ton press, where it was fed C 1035 cold-rolled strip, 0.065 in. thick. Performance was excellent, the die performing economically at the high speed at which the press operated. About 800,000 pieces were produced between grinds.



Lehigh H, our high-carbon, high-chromium grade of air-hardening tool steel, is ideal for tough assignments because of its outstanding wear-resistance and toughness. It is well known for its minimum distortion in heat-treatment, and high compressive strength.

TYPICAL ANALYSIS

Carbon 1.55	Molybdenum 0.80
Chromium 11.50	Vanadium 0.40

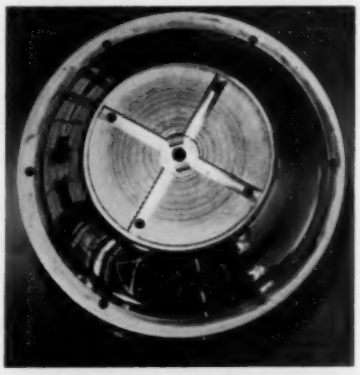
Look into the advantages of Lehigh H by giving it a try. Chances are good that your local Bethlehem tool steel distributor has Lehigh H in stock. Give him a call.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Follow Up With Temper When Drilling Hardened Tools

When necessary to drill holes in hardened tools or dies to incorporate dimensional changes, such drilling is usually done with a triangular drill made of a cast stellite or a sintered carbide. This type of drill operates by generating frictional heat sufficient to locally anneal the steel, so that the cutting edges can scrape the metal away in the path of the drill. All tool steel grades, regardless of how high the hardness developed by heat-treatment, can be drilled in this manner.

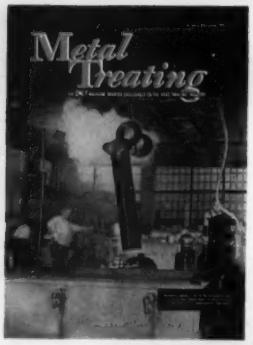
It is obvious that such a procedure will produce stresses in tools or dies which, because of heat-treatment, already contain residual stresses. It is important, therefore, that the drilling operation on hardened tools always be followed by a tempering operation. Tempering should be carried out at a temperature equal to, or slightly below, the final temper used in the original heat-treatment operations.



Lustre-Die Provides High Sheen When Making Plastic Parts

This core for a plastic injection mold, made by Interstate Mold & Hobbing Co., Union, N. J., is for use in manufacturing a decorative bowl for household use. It is made of Lustre-Die, an electric-furnace steel of well-balanced analysis, which we alloy-fortify to increase its depth of hardenability and mechanical properties. Use Lustre-Die when you want unusually high sheen on plastic parts. You'll like it.

The only magazine devoted exclusively to the Heat Treating Industry



If you sell

Heat Treating Equipment and Supplies

here are 4 basic reasons why

METAL TREATING *should*

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It is the quality of the editorial content which turns recipients into readers, and what you want to buy is readers.

2. **READERSHIP:** Editorial content strictly limited to audience interest and properly balanced with advertising content establishes reader acceptance. This is proved by the return of thousands of Readers' Service inquiry cards.

From the last 12 issues over 6,000 inquiries were received, making an average of over 500 inquiries per issue, or 15 per cent of the average circulation receiving these issues. *In addition over 300 "Letters to the Editor" constantly assure us of reader interest.*

3. **CIRCULATION DATA:** The controlled and BPA audited circulation reaches over 8,000 people—the important personnel who are engaged in some phase of heat treating either in heat treating departments of manufacturing plants or in commercial heat treating plants—all of whom buy your products.

The thoroughness and effectiveness of the coverage is evidenced by the fact that there are only slightly more than 6,000 plants employing more than 20, including commercial heat treaters, engaged in heat treating operations in the entire United States. *You do not pay for excess circulation.*

4. **COSTS:** An entire year's campaign (6 issues) of a one-page ad in color ($1,680.00) costs much less than fewer insertions in the majority of all other metalworking trade magazines.

Various reader surveys conducted by our advertisers themselves reveal that METAL TREATING is the lowest in cost per page per reader and ranks within the first five of trade journals read and preferred by the recipients of the questionnaires.

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APPRENTICE CORNER

(*Continued from page 16*)

Surface Hardening by Selective Heating Methods

The fact that hardness increases with increasing carbon content enables us to use this phenomenon to produce a high surface hardness merely by selectively heating the outer surface layer to the hardening temperature to a given depth and then quenching at a rate to produce complete hardening. The area beneath the selectively hardened zone will have been unaffected by the heating and quenching operation. Flame hardening and induction hardening are processes of surface hardening utilizing this principle.

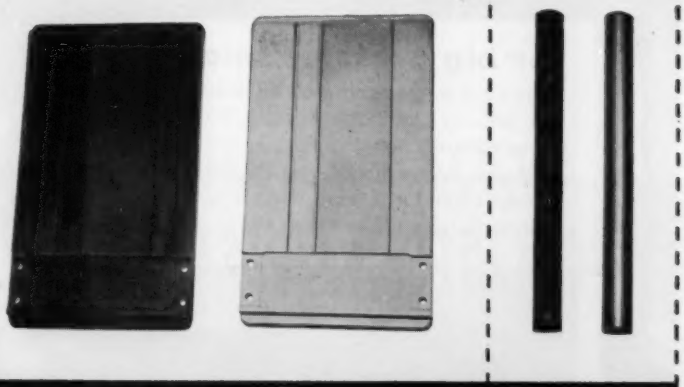
The Flame Hardening Process

Flame hardening is defined variously, but essentially it is a process used to harden a ferrous alloy by heating it above the transformation range (austenitizing) by means of a high temperature flame and then quenching at a rate that will produce complete hardening. The flame impinges directly on the workpiece.

The essentials for flame hardening comprise the fuel gases such as oxygen and acetylene, oxygen and propane, or air and natural gas, and a flame head in which are burned the fuel gases. Varying temperatures are attainable with the different fuel gases; but oxygen and acetylene because they produce the highest flame temperature and because equipment to burn them is readily available are the most widely used. However the so-called radiant and high velocity types of burners or flame heads which generally burn air-natural gas mixtures are coming into wider use.

The principal methods of flame hardening are: (1) the spot or stationary method where the area to be hardened is heated locally to the desired depth and then quenched; (2) the progressive method wherein the workpiece is heated progressively by the flame head and the quench applied di-

(*Continued on page 34*)



STEELETTS® clean toughest heat treat scale

cut abrasive consumption 73.8%

AT COMMERCIAL STEEL TREATING COMPANY

Steeletts, the heat treated electric furnace steel grit, reduce abrasive consumption and maintenance costs while cleaning even the toughest heat treat scale at Commercial Steel Treating Corp. One of the largest job heat treat companies in the United States, this Detroit firm changed to Steeletts only after exhaustive tests.

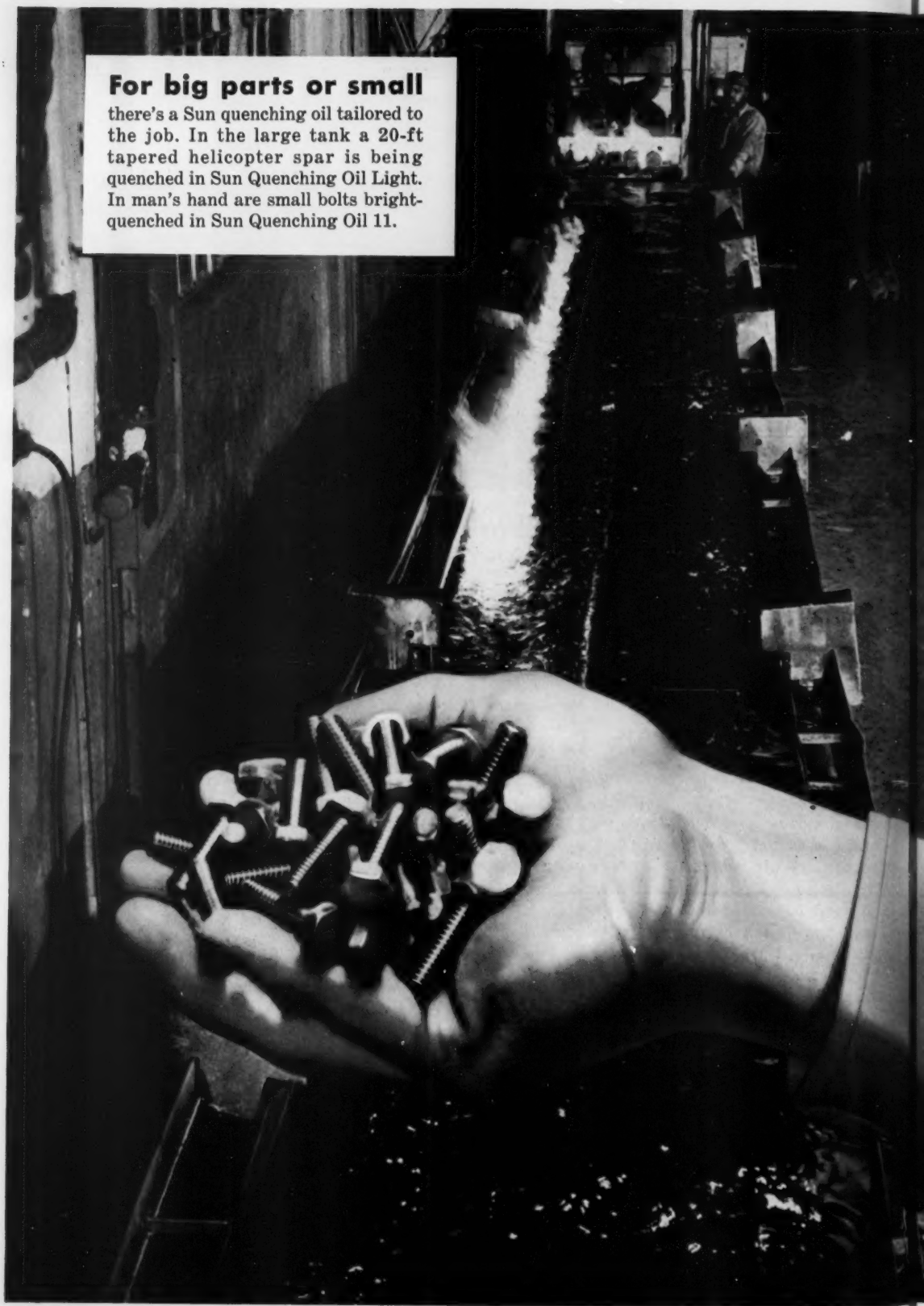
Mr. Anthony J. Beck, Plant Engineer, points out the first consideration of a job plant must be finish, because customers demand thorough cleaning and uniformity of finish from batch to batch. Steeletts scored high on this count and gave improved speed, too. But in addition to these advantages, Steeletts outlasted chilled iron 4 to 1 in tests conducted in the same blast cleaning machine on the same type of work. Grit consumption was cut 73.8%, and Mr. Beck pointed out, "We find that when a grit has a longer life, equipment maintenance savings are greater than the savings we make in grit costs."

Investigate the savings you can make in grit costs and maintenance costs by using Steeletts. Write today for Bulletin No. 901-D.

PACKAGED IN 50 lb. CARTONS

WHEELABRATOR CORPORATION

855 South Byrkit Street, Mishawaka, Indiana



For big parts or small
there's a Sun quenching oil tailored to the job. In the large tank a 20-ft tapered helicopter spar is being quenched in Sun Quenching Oil Light. In man's hand are small bolts bright-quenched in Sun Quenching Oil 11.

SUN QUENCHING OILS CAN SOLVE ALL OF YOUR OIL-QUENCH PROBLEMS

SUN QUENCHING OIL LIGHT keeps coolers cleaner longer because it has a natural detergency that cuts down sludge formations. By using Sun Quenching Oil Light many people have cut cooler maintenance costs by as much as 75 to 80 per cent. And they're getting low drag-out and uniform quenching.

SUN QUENCHING OIL 11 has a high flash point. Moreover, it resists breakdown at high temperatures. These characteristics make it ideal for bright quenching and for use in systems operating at above-normal temperatures.

SUNQUENCH 78 is a high-speed quenching oil. You can use it whenever the nature of the steel, the size and shape of the parts, or other conditions make it difficult to get satisfactory results with conventional quenching oils. By using Sunquench 78, steels of lower hardenability may often be used to replace more expensive steels.

IN ADDITION to these three quenching oils, Sun makes several others for special applications. No matter what your quenching problem, there's a Sun quenching oil to solve it.

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Free technical bulletins are available to give you full details of Sun's outstanding quenching oils. Call your Sun representative or write for **Sun Quenching Oil 11 (Bulletin 29), Sun Quenching Oil Light (Bulletin 37), Sunquench 78 (Bulletin 45).**

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SUN OIL COMPANY PHILADELPHIA 3, PA.

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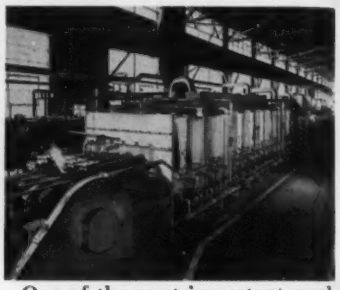
IN CANADA: SUN OIL COMPANY LIMITED, TORONTO AND MONTREAL

NEWS TO HEAT TREATERS...

BRIGHT ANNEALING FURNACE

A new continuous bright annealing furnace said to be capable of maintaining a high quality finish on welded stainless steel tubing from ¼" O. D. to 4" O. D. has been installed at the Steel & Tubes Division of Republic Steel. It has a rated capacity of 1,000 pounds per hour at a maximum temperature of 2100°F.

Believed to be the largest of its kind in the stainless tube industry, it also retains the surface qualities of the original flat-rolled steel finish on welded stainless tubing without the subsequent need for polishing for many applications. As a result, it eliminates the high cost of polishing borne by the tube purchaser; it also reduces ordinarily required pickling operations.



One of the most important quality advantages claimed of this process is the assurance of a scale-free inside diameter, especially on long length small diameter tubes which are difficult to pickle clean when annealed in a furnace that allows a scale to form.

Use of the furnace has resulted in the following operational advantages according to Republic:

(1) Improved surface finish resulting from the elimination of heavy scaling produced by open type furnace;

(2) Reduced maintenance and deterioration of building and pickling equipment due to the elimination of hydrofluoric acid;

(3) Reduced handling and transportation.

For further information circle No. 1

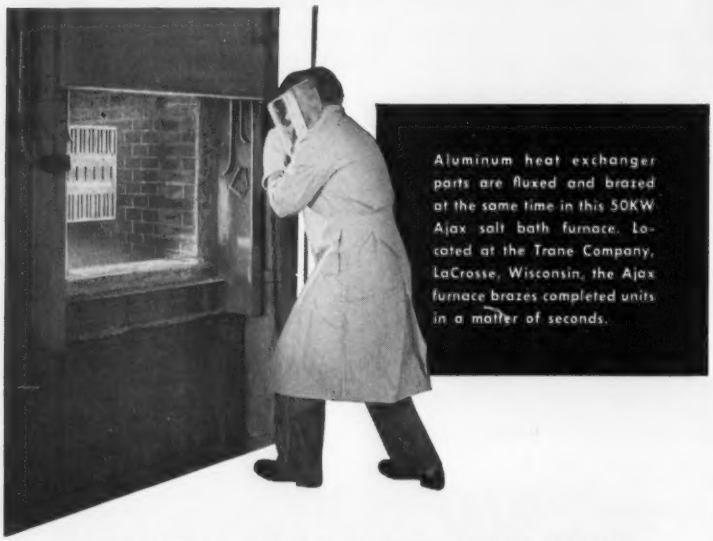
NEW MTI MEMBERS

The following two companies have been admitted to membership in the Metal Treating Institute with the necessary approval of the Board of Trustees:

United Heat Treating Company
2005 Montgomery Street
Fort Worth 7, Texas
Mr. Leon L. Sanders
—President

Ipsenlab of Canada Limited
27 Bermondsey Road
Toronto 16, Ontario
Mr. Frank Hobbs
—General Manager

(Continued on page 26)


Aluminum heat exchanger parts are fluxed and brazed at the same time in this 50KW Ajax salt bath furnace. Located at the Trane Company, LaCrosse, Wisconsin, the Ajax furnace brazes completed units in a matter of seconds.

FASTER, BETTER BRAZING

for ALUMINUM ASSEMBLIES

Dip brazing boosts output . . . cuts costs . . .
assures fast, sound brazes to close tolerances

Dip brazing in Ajax Electric Salt Bath Furnaces puts the fabrication of aluminum assemblies—even highly complicated ones—on a low cost mass production basis.

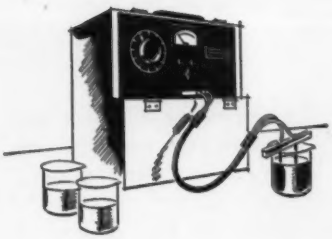
Assemblies are preheated to 1000°F. then immersed in the molten salt where all joints are brazed quickly and simultaneously. Distortion is minimized because assemblies are heated uniformly by conduction. Thus, polished surfaces, often difficult to heat by radiation, offer no problem. Moreover, extremely close temperature control, inherent with the salt bath method, eliminates the possibility of overheating.

Clean, fast, high quality brazes to uniformly close tolerances are assured.

AJAX HULTGREN electric SALT BATH furnaces

AJAX ELECTRIC COMPANY
940 Frankford Ave. Philadelphia 23, Pa.

Associates: Ajax Engineering Corp., Ajax Electrothermic Corp.



"Quenchol Demonstrator showed...They needed More Cooling Power to stop spotty hardness!"

A large manufacturer of locking pins recently had a problem getting uniform high hardness on SAE 1074 steel. Hardnesses varied from 34 to 61 R_c Hardness. Since this and other factors pointed to the competitive oil they were using, they asked Sinclair Representative Russell Smith for his evaluation. Mr. Smith reports:

"Spotty hardness indicated that the oil being used lacked cooling power. A comparison test on the Sinclair Quenchol Demonstrator showed that this oil had a cooling power rating of 784 . . . as compared with a rating of 1225 for QUENCHOL 521!"

This test convinced them!

Mr. Smith continues, "The Quenchol Demonstrator test results persuaded this manufacturer to install QUENCHOL 521 immediately. Now they are getting an increased and uniform hardness range of 59 to 65 R_c Hardness. Moreover, with QUENCHOL 521 *working loads have been increased 67%*, from 3 tons to 5 tons per quench, using the identical equipment and procedures! Needless to say, this manufacturer is very pleased with the cooling power and performance of QUENCHOL!

Try a FREE Quenchol Demonstrator test on *your* present quenching oil. See how it compares with the amazing cooling power of QUENCHOL 521. Make arrangements through your local Sinclair Representative, or write to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. Free literature is available, and there is no obligation.

SINCLAIR

METAL WORKING OILS

Facilities of...
COMMERCIAL HEAT TREATERS
can cut YOUR costs

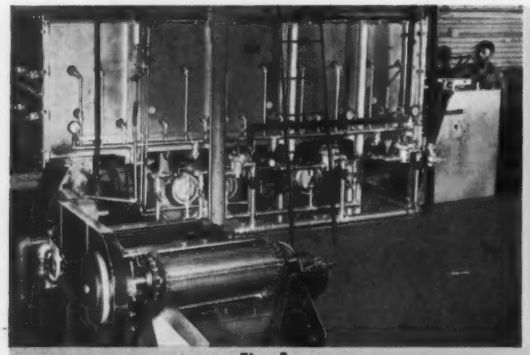


Fig. 1

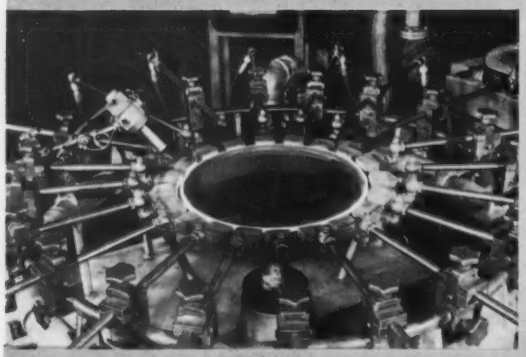


Fig. 2

Fig. 3

An MTI commercial heat treater is located near you and is ready to serve your needs by performing "Custom-tailored" heat treating operations.

Because all members of the MTI are specialists with complete service facilities centralized in one plant, they are equipped to offer you a variety of heat treating processes—atmosphere hardening, carburizing, nitriding, annealing, cyaniding, etc.

For example, Fig. 1 shows an installation of a shaker hearth furnace with a continuous automatic quenching tank and a conveyor to a washing machine.

Fig. 2 illustrates a gas flame hardening unit featuring accurate temperature control and using two semi-circular gas manifolds mounted on movable carriages with 20 or more burner heads.

A further example of versatile and dependable equipment found in a commercial heat treating plant is seen in Fig. 3. The specially designed furnace conveyor belt carries over 35 lbs. per sq. ft. in normal service and sometimes as much as 5000 lbs. are loaded on it with pieces ranging from ½ lb. to 100 lbs. and temperatures up to 1650°.

Possessing such equipment together with many other specialized facilities and employing the trained personnel with technical knowledge and experience is the business of the commercial heat treater. Teamwork between him and the manufacturer can cut *your* costs.

Get in touch with the Metal Treating Institute or any MTI member listed on the facing page when you need heat treating services.

WRITE FOR *the MTI booklet called:*
"STRATEGIC USE of OUTSIDE HEAT TREATING FACILITIES CAN CUT COSTS."

METAL

Consult any of these HEAT TREATING SPECIALISTS

CALIFORNIA

Certified Steel Treating Co.
2454 E. 58th St., Los Angeles 58

Hollywood Heat Treating Co.
6902 Santa Monica Blvd., Los Angeles 38

Lindberg Steel Treating Co.
2910 S. Sunol Drive, Los Angeles 23

Cook Induction Heating Co.
4925 East Slauson Ave., Maywood

CONNECTICUT

Commercial Metal Treating, Inc.
89 Island Brook Ave., Bridgeport 6

Stanley P. Rockwell Co.
296 Homestead Ave., Hartford 12

ILLINOIS

Senecca Heat Treating Co.
124 S. Batavia Ave., Batavia

Accurate Steel Treating Co.
2226 W. Hubbard St., Chicago 12

Dura-Hard Steel Treating Co.
2112 W. Rice Street, Chicago 22

Pearson Industrial Steel Treating Co.
5757 W. Ogden Ave., Chicago 50

Perfection Tool & Metal Heat Treating Co.
1756 West Hubbard St., Chicago 22

Fred A. Snow Co.
1942 West Kinzie St., Chicago 22

American Steel Treating Co.
P. O. Box 225, Crystal Lake

Eklund Metal Treating, Inc.
721 Beacon St., Loves Park

Lindberg Steel Treating Co.
1975 N. Ruby St., Melrose Park

O. T. Muhlemeyer Heat Treating Co.
1531 Preston St., Rockford

C. U. Scott & Son, Inc.
1510 First Ave., Rock Island

INDIANA

Quality Steel Treating Company
1630 Locust Street, Anderson

MASSACHUSETTS

New England Metallurgical Corp.
475 Dorchester Ave., South Boston 27

Porter Forge & Furnace, Inc.
74 Foley St., Somerville 43

Greenman Steel Treating Co.
284 Grove St., Worcester 5

MICHIGAN

Anderson Steel Treating Co.
1033 Mt. Elliot Ave., Detroit 7

Bosworth Steel Treating Co.
18174 West Chicago Blvd., Detroit 28

Commercial Steel Treating Corp.
6100 Tireman Ave., Detroit 4

Commonwealth Industries, Inc.
5922 Commonwealth Ave., Detroit 8

Standard Steel Treating Co.
3467 Lovett Avenue, Detroit 10

Vincent Steel Process Co.
2424 Bellevue Ave., Detroit 7

State Heat Treat, Inc.
520 32nd Street, S. E., Grand Rapids 8

Lincoln Heat Treat, Inc.
21235 John R, Hazel Park

Metallurgical Processing Company
2703 East Nine Mile Road, Hazel Park

Royal Oak Heat Treat, Inc.
21419 Dequindre, Hazel Park

American Metal Processing Co.
12000 East Nine Mile Road, Van Dyke

MINNESOTA

Metallurgical, Inc.
900 East Hennepin, Minneapolis 14

MISSOURI

Metallurgical, Inc.
1727 Manchester Ave., Kansas City 8

Lindberg Steel Treating Co.
650 East Taylor Ave., St. Louis 15

Paulo Products Co.
5711 West Park Ave., St. Louis 10

NEW JERSEY

Ace Metal Treating Corp.
611 Grove St., Elizabeth

American Metal Treatment Co.
Highway 25 and LaFayette St., Elizabeth

Benedict-Miller, Inc.
Marin Ave. and Orient Way, Lyndhurst

Bennett Heat Treating Co., Inc.
246 Raymond Boulevard, Newark 5

L-R Heat Treating Co.
107 Vesey St., Newark 5

Temperature Processing Co., Inc.
228 River Road, North Arlington

NEW YORK

Fred Heinzelman & Sons
138 Spring St., New York 12

Alfred Heller Heat Treating Co., Inc.
391 Pearl St., New York 38

Lindberg Steel Treating Co.
620 Buffalo Road, Rochester 11

Rochester Steel Treating Works
962 Main Street, E., Rochester 5

Syracuse Heat Treating Corp.
1223 Burnet Ave., Syracuse 3

OHIO

Queen City Steel Treating Co.
2980 Spring Grove Ave., Cincinnati 25

Ferrotherm Co.
1861 E. 65th St., Cleveland 3

Lakeside Steel Improvement Co.
5418 Lakeside Ave., Cleveland 14

George H. Porter Steel Treating Co.
1273 East 55th Street, Cleveland 3

Reliable Metallurgical Service, Inc.
3827 Lakeside Ave., Cleveland 14

Winton Heat Treating Co.
20003 West Lake Road, Cleveland 16

Dayton Forging & Heat Treating Co.
2323 East First St., Dayton 3

Ohio Heat Treating Co.
1100 East Third St., Dayton 2

PENNSYLVANIA

Robert Wooler
Limekiln Pike, Dresher

J. W. Rex Co.
834 West 3rd St., Lansdale

Drever Company
220 West Cambria St., Philadelphia 33

Lorenz & Son
1351 N. Front St., Philadelphia 22

Metlab Company
1000 East Mermaid Lane, Philadelphia 18

Wiedemann Machine Co.
4272 Wissahickon Ave., Philadelphia 32

Pittsburgh Commercial Heat Treating Co.
49th St. and A.V.R.R., Pittsburgh 1

Pittsburgh Metal Processing Co. Inc.
1850 Chapman Street, Pittsburgh 15

TEXAS

Dominy Heat Treating Corp.
P. O. Box 5054, Dallas

Superior Heat Treating Co., Inc.
P. O. Box 1686, Fort Worth 1

United Heat Treating Company
2005 Montgomery Street, Fort Worth 7

Cook Heat Treating Co., of Texas
6233 Navigation Boulevard, Houston 11

Lone Star Heat Treating Corp.
5212 Clinton Dr., Houston 20

WISCONSIN

Allied Metal Treating Corp.
830 S. Fifth St., P. O. Box 612, Milwaukee 1

Metal Treating, Inc.
720 South 16th St., Milwaukee 4

Supreme Metal Treating Co.
4440 West Mitchell St., Milwaukee 14

Thurner Heat Treating Co.
809 West National Ave., Milwaukee 4

Wisconsin Steel Treating & Blasting Co.
1114 South 41st Street, Milwaukee 15

Harris Metals Treating Co.
4100 Douglas Ave., Racine

CANADA

B. & W. Heat Treating Limited
70 Borden Ave., S. Kitchener, Ontario

Ipsenlab of Canada Limited
27 Bermondsey Road, Toronto 16, Ontario

MTI
MASTER CRAFTSMEN
METAL TREATING INSTITUTE

EATING INSTITUTE

271 AVENUE • NEW ROCHELLE, N. Y.

or consult the MTI members listed above

NEWS TO HEAT TREATERS

(*Continued from page 22*)

METALS TECHNOLOGY COURSE

A new course in Metals Technology will be inaugurated at Wentworth Institute, Boston, Mass., this forthcoming September, according to an announcement by H. Russell Beatty, Wentworth president.

This course is being instituted in the curriculum of Wentworth Institute as a result of a survey conducted among firms in the fast-growing metals industry in New England which disclosed a need for more trained engineering technicians in this field.

Graduates of this two-year course will receive an Associate in Engineering degree.

The course is designed to train engineering technicians in metal processing industries. In the second year, students may specialize in foundry operations, metal fabrication or *heat treatment of metals.*

Graduates will qualify for positions as laboratory technicians, engineering assistants, production supervisors, methods analysts and technical salesmen in the metals processing industries or in the machinery and equipment industry.

For further information circle No. 2

BACKLOG OF ORDERS

The backlog of orders for industrial furnaces is now at an all-time peace-time high, the Industrial Heating Equipment Association announces. As of December 31, 1956, the Industrial Heating Equipment Association member companies reported a backlog of $110,554,000 of orders for industrial furnaces. This is an increase of 42% over the comparable figure for December 31, 1955—$77,758,-000.

Shipments of industrial furnaces for 1956 totalled $123,344,000 among the Industrial Heating Equipment Association member companies. In 1955, the figure was $77,758,000. This is an increase of 47%.

STEEL BASKET

A sturdy steel basket, specially constructed for moving heavy aluminum castings to and from heat treating furnace and quenching tanks, is announced by Wiretex Manufacturing Co., Inc., Bridgeport, Conn.

The unique structure of the basket, with its four lifting hooks, makes it easy to lift the castings by means of a movable crane. In addition, unnecessary secondary handling is entirely eliminated; a specially constructed door in the front of the basket facilitates unloading.

Made of steel, the basket measures 84″ x 60″ x 51″ deep. The frame of the basket is made of 3″ x 3″ x ⅜″ angles. Four lifting hooks are made of 1″ square bar stock. The ¾″ space, .162 dia. wire mesh and angle frame are bolted to one another. A 57″ x 75″ shelf adds to the versatility of the furnace basket in innumerable applications. Each basket weighs approximately 2,000 pounds and is capable of handling a workload exceeding 10,000 pounds.

For further information circle No. 3

VACUUM HEAT TREATING FURNACE

A versatile vacuum heat-treating furnace is now available to meet advanced metal-working requirements in aircraft, electronic, and industrial fields.

Designed and developed by the Pacific Scientific Company, Los Angeles, this vacuum furnace is proving particularly valuable in out-

1500° IN 5 MINUTES
2300° IN 30 MINUTES

johnson
NUMBER 120 HI-SPEED FURNACE

That's the kind of quick heating action you get with this compact, powerful furnace. It's economical to operate, too. Fast heat-up saves time and gas. High-temperature insulated firebox, 5″ by 7¾″ by 13½″, gives even hardening of high speed and carbon steel dies, tools and small parts. Temperature easily regulated. G.E. motor and Johnson Blower included. 120,000 BTUs per hour.

Pedestal style, F.O.B. Factory....$167.00
No. 120 also available in bench style.

Write today for free Johnson Catalog
Johnson Gas Appliance Company
605 E Avenue NW, Cedar Rapids, Iowa

johnson
If it burns gas look to Johnson
Since 1901

gassing titanium and titanium alloys, and in developing new surface-hardening techniques.

Operated from 1300°F. to 1600°F. under vacuums up to 0.2 microns, and frequently at temperatures in excess of 2000°F., this furnace may be used for a variety of specialized jobs. In addition to out-gassing re-active metals, scale-free heat treating of steels, and vacuum brazing, it is used for diffusion coating and impregnation and aging of precipitation hardening alloys. Experience already gained indicates that new metallurgical techniques built around this type of equipment will find increasing use in industry.

Basically, the unit consists of an electrically-heated furnace with controls and thermocouples to hold temperature variations within close limits; a high-speed diffusion pump; mechanical roughing pump, and a vacuum-tight retort.

The furnace is so designed that it may be loaded and unloaded without disturbing the piping or vacuum lines, with water-jacketed cooling to maintain uniform temperatures. It may be back-flushed with inert atmospheres for surface-hardening of titanium.

Due to its high-temperature operation and its inside pressures of less than two microns, the retort proper is fashioned of Inconel nickel-chromium alloys. In addition to resisting oxidation and corrosion of the retort, these alloys can bear the extra burden of serving as a means of heat deflection in work holders and baffles.

Illustrative of the performance of Pacific's vacuum furnace is the cycle which has been developed for out-gassing titanium alloys. After a full vacuum has been attained at ambient temperatures in the retort, the work load is brought up to approximately 1300°F. The mechanical pump is used until pressure is below 300 microns, and at that point, the diffusion pump goes into operation and the system brought up to temperature. At the conclusion of the heating cycle, the furnace is shut down, while blowers blast cold air jets against the retort to accelerate cooling. Temperature of the work load generally is brought below 400°F. before releasing the vacuum. Cooling of the work load may be accomplished in about four hours, although retort temperature drops much more rapidly.

In connection with titanium, vacuum out-gassing has made possible the recovery of millions of dollars worth of hydrogen-embrittled scrap. For example, several manufacturers utilize the mechanical pump pressure to indicate gas evolution being handled by the system. Pressure usually drops from 10 to 20 microns (based on a full charge of material in the retort) after several hours of degassing.

For small loads, material ordinarily is held at temperature for a minimum of six hours, or for a longer period if mechanical pump pressure is over 30 microns after that minimum time. This six-hour minimum was established for sheet materials, and longer periods are required to out-gas thicker sections of titanium alloys.

For further information circle No. 4

ALUMINUM SCALE REMOVER

Heatbath Corporation has just introduced a new product, "Deoxide" for desmutting, deoxidizing and removing heat scale from aluminum.

Deoxide is used with water, 8 to 16 oz. per gallon at room temperature. Time of treatment will vary from 30 seconds to 10 minutes, depending upon application.

For further information circle No. 5

FOR SALE AT BARGAIN!

200 INCONEL WIRE BASKETS—
HEAVILY CONSTRUCTED

Sizes—43¾" x 25¾" x 8" height
44¼" x 25¼" x 8" height
Also for sale 100 Separators measuring 44½" x 25".
Basket price $85.00 each f.o.b. Chicago
Better price for quantity buyers.

Write to:

ESTES MACHINERY COMPANY
825 West Lake Street
Chicago 7, Illinois
MOnroe 6-1814

WANTED

1—33" x 36" Pit Type Heat Treating Furnace. Gas Fired, 1650° with Full Automatic Controls.
1—33" x 36" Pit Type Heat Treating Furnace. Electric, 1200° Plus or Minus 5° F. with Full Automatic Controls.

Write
SAVANNAH MACHINE AND FOUNDRY COMPANY
FOUNDRY DIVISION
P. O. BOX 590
SAVANNAH, GA.

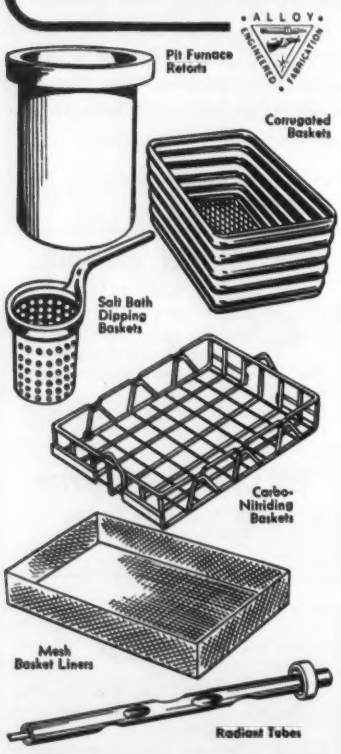
NOW Available...

MISCO Heat-Treating Tools from Stock!

MISCO heat-treat process equipment is engineered and fabricated by qualified specialists in the field of heat-resisting alloy materials.

With a wide variety of job-proven heat-resisting steel products available for immediate delivery, Misco Fabricators provide a real service to heat-treaters, who no longer need carry an expensive inventory of equipment.

Remember, whatever your need, Misco Fabricators offer sound, economical designs in the best metal for your purpose. It pays to do business with Misco Fabricators—Specialists in Nickel-Bearing Alloy Fabrication.



Special Equipment Designed and Made to Order

MISCO FABRICATORS, INC.

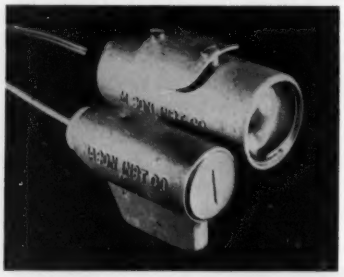
Designers, Builders, Fabricators of Heat-Resisting Alloy and Stainless Steel Equipment

2420 WILLS AVENUE • MARYSVILLE, MICHIGAN

TELEPHONE YUKON 5-6151

PHOTOELECTRIC CONTROL

A compact photoelectric control is announced by the Mason Instrument Co. Small in size, it is adaptable for counting, sorting, color matching, level detection, edge register, safety, automatic shutoff and alarm, smoke and turbidity control, etc.



Its unique "cat's eye" receiver and efficient optical system enables control of machine position within close limits. The "cat's eye" slit can be rotated to suit conditions, and can control in the horizontal, vertical or any attitude. This slit also lends itself to readout with a suitable optical shaft position indicator.

For further information circle No. 6

HEATBATH SALES REPRESENTATIVE

Heatbath Corporation announces the appointment of Bernard C. Lindstrom as Technical Sales Representative in New York State, exclusive of the Metropolitan New York City area.

NEW TUBE FURNACE FOR HANDLING COILED OR STRIP STOCK

A new sectionalized tube-type electric furnace, just recently announced by the Pereny Equipment Company, Columbus, Ohio, provides flexibility for any individualized requirement for heat treating wire, rod or strip steel on a continuous-run schedule.

Assembled of sectional units, of either five feet or eleven feet lengths, each having its own independent, integral controls, it can be lengthened or shortened by simply adding or removing units. Simplicity of connecting units (as shown in illustration) makes it easy to rearrange or relocate at any time, to suit altered production specifications or plant layout.

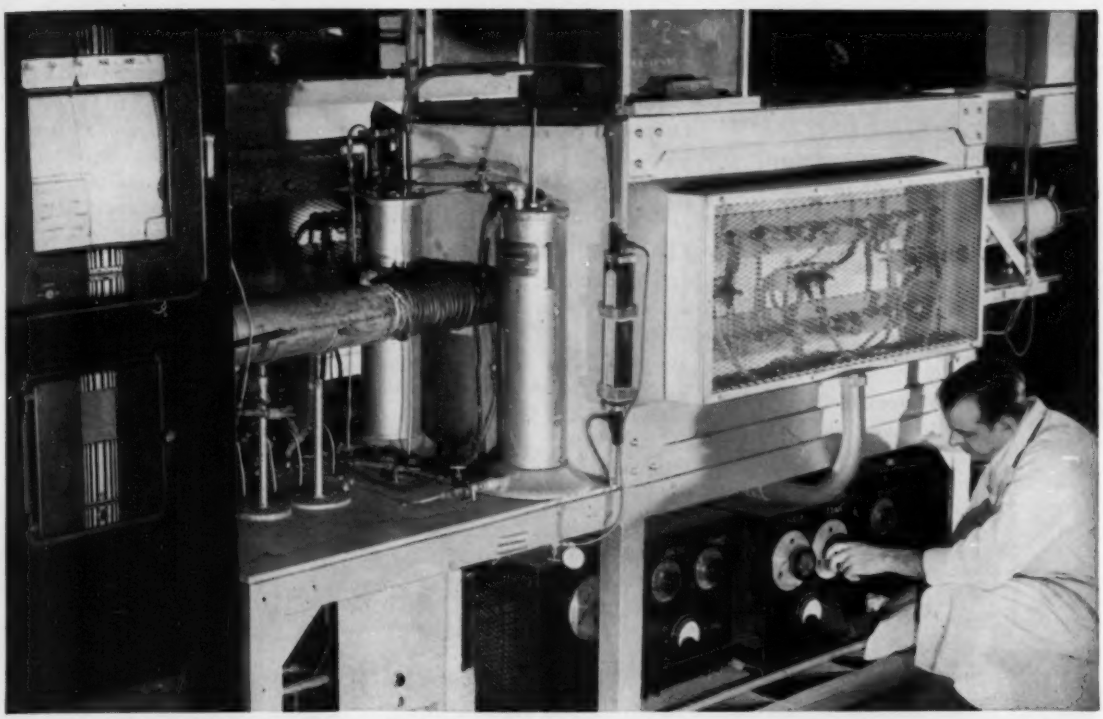
By being independently controlled, any single unit, complete in itself, can also be used separately. It may be readily placed into service by merely connecting it to the source of power.

Through its flexibility as to length, this furnace is readily adaptable to requirements calling for "holding" the material being heated at a given temperature for relatively long periods of time, as it continuously moves through the furnace. Or it can handle any desired daily volume of work by extending the furnace length to accommodate the necessary speed of travel of the material through the furnace at the prescribed temperature.

The individual unit-control in a composite multiple assembly permits temperature "zoning" or any special combination of temperature regulation peculiar to the work involved or to the thickness of stock being heat treated.

Over-all dimensions of a typical unit, with a maximum operating temperature of 1250°F., is 17" wide x 17" high (plus legs) x 11' long. The "hot zone" is 6 inches in diameter and 10 feet long. Muffle is 6 inch I. D. alloy tubing for the full length. Multiple sectioned, alloy sheathed heaters completely surround the muffle. Insulation is graded, super-duty, lightweight refractories. The exterior housing is of heavy-gauge steel, reinforced throughout.

For further information circle No. 7



Continuous-type tubular muffle furnace. Inconel alloy muffles take thermal shock and temperatures in the 2300°F. to 2400°F. range . . . save Sylvania $3000 annually in down-time and replacement costs. Muffles are supported by contoured refractory bricks.

Inconel muffle produces sinter at 2400°F...and saves $3000 per year

Sylvania-Corning Nuclear Corporation, Bayside, N. Y., uses a high temperature sintering technique to make stainless steel parts.

A lot depends on the furnace muffle.

For one thing it has to take temperatures in the 2300° to 2400°F range.

For another, it has to withstand thermal shock when the cold sintering boat is stoked into the hot furnace. Cracks can't be tolerated either, because a controlled atmosphere is maintained.

An Inconel nickel-chromium alloy muffle is the answer.* It handles the high temperatures . . . withstands the thermal shock . . . saves this producer $3000 annually in downtime and replacement costs.

Inconel alloy properties key to muffle performance

Inconel alloy retains its useful strength at extremely high temperatures . . . shows exceptional resistance to oxidation, too.

Inconel alloy welds and forms easily, too. You can make it into practically any shape. Sylvania-Corning Nuclear Corporation use their Inconel alloy muffles in a variety of shapes: round, rectangular and square.

For particulars on the advantages and economies of Inconel alloy, write for "Keeping Costs Down... As Temperatures Go Up."

*Registered trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N. Y.

INCO NICKEL ALLOYS

Inconel...*for long life at high temperatures*

LOW-TEMPERATURE CHILLING UNIT

A new low-temperature chilling machine with a 4 cu. ft. chamber has been developed by Cincinnati Sub-Zero Products, Cincinnati, Ohio, manufacturers of industrial chilling equipment.

The new unit is designed for laboratory testing in regard to quality control and product development uses. It has a net thermal capacity of approximately 600 BTU/hr. at –120°F., with a temperature selection from +80°F. to –120°F., and full-range pull down in 45 minutes.

Outside dimensions of the unit are: 59″ high x25″ deep x 26″ wide. The chilling chamber, 18″ high x 18″ wide x 17″ deep, is made of electric-welded pressure-tite 14-gauge steel, hot dip zinc-coated. The net clear working area is 18″ high x 18″ wide x 12″ deep.

Full access to the chamber area is provided by the front opening door, which has a 12″ x 12″ multipane frostproof window. Interior illumination is furnished by a 60-watt Lumilite. An electrically-operated lifetime red light will remain on during normal operation, going off only in the event of power failure.

Refrigerant tubes completely surround the chamber with a "blanket" of sub-zero cold. The chamber wall is equipped with a Krack Model F-90-BC Fin Coil and Blower, which provides mechanical convection of air and uniform temperatures throughout the chamber. The cascade refrigeration system is electronically leak-tested. By the addition of strip heaters, the temperature range can be extended to +200°F.

For further information circle No. 8

METALLURGICAL RESEARCH

Mr. William C. Denison announces the organization of the Denison Research Foundation, a not-for-profit Ohio Corporation. Denison Research will serve industry and the U. S. Government by providing research talent and facilities for conducting a wide variety of research. Initial emphasis will be on projects in the electronic, mechanical, metallurgical, ceramic and management fields.

The Denison Research Foundation is located at Powell, Ohio, north of Columbus. Mr. Jack Pedersen, formerly an executive of the Detroit Harvester Co. of Detroit, Mich., has been appointed Director of the Foundation. Mr. Robert R. Hyatt, formerly General Counsel and Administrative Staff Assistant for The Denison Engineering Co., Columbus, Ohio, was appointed Associate Director.

For further information circle No. 9

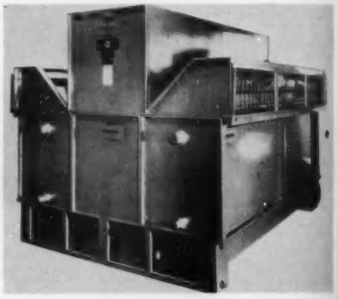
HEAT EXCHANGER

Niagara Blower Company announces new apparatus giving close control of temperatures for all heat treat quenching by water, oils, or solutions. The new machine named the Sectional Aero Heat Exchanger cools by evaporation and controls the temperature by modulating the use of outdoor air.

The quench solution to be cooled flows thru two parallel-mounted coil sections both of which are continuously drenched with a water spray. A small portion of this water evaporates while the balance is recirculated by a pump. Air enters through dampered intakes above the coils, travels downward through the sprays and then enters a central plenum between the two sections, at which point the entrained moisture is eliminated. The air then moves upward and a propeller fan ejects it into the atmosphere.

The quench fluid in the cooling coils is effectively cooled by transfer of about 1000 BTU to the air stream for every pound of water evaporated. The air recirculation system holds the temperature constant, removing the heat directly at the rate of input. If heat is required for a warm-up at the start of a run, it is provided either with steam or electricity by a heater in the spray water.

Because heat is removed at the rate of input, quench bath storage, tanks, piping, pumps may all be smaller, saving much equipment cost.



The equipment may be installed anywhere; the usual location is outdoors, on the ground or on a roof. In this model there are four sizes affording capacities from 7,000,000 to 18,000,000 BTU.hr under standard conditions. The maximum space required in ground plan is 194″ by 140½;″ in height 125⅜″. The weight range is from 9300 to 20,500 lbs., approximately. The manufacturer also builds both smaller and larger units in other types.

There are many industrial applications for this cooling equipment. It is used with water, oil or brine quench baths, and by controlling the quench temperature it improves the heat treating quality and prevents rejection losses.

For further information circle No. 10

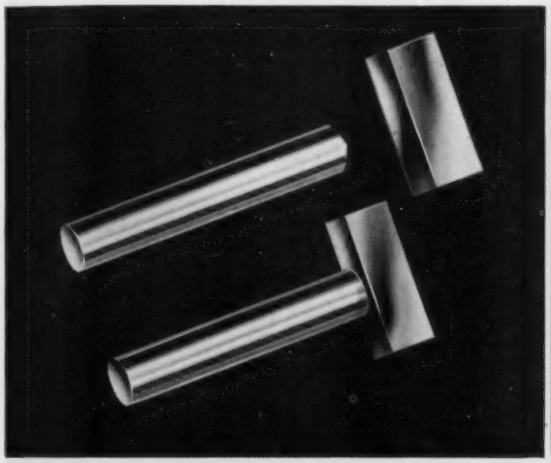
LIQUID HONING

A positive method of detecting cracks and other imperfections in new and reground carbide tools is claimed for surface conditioning

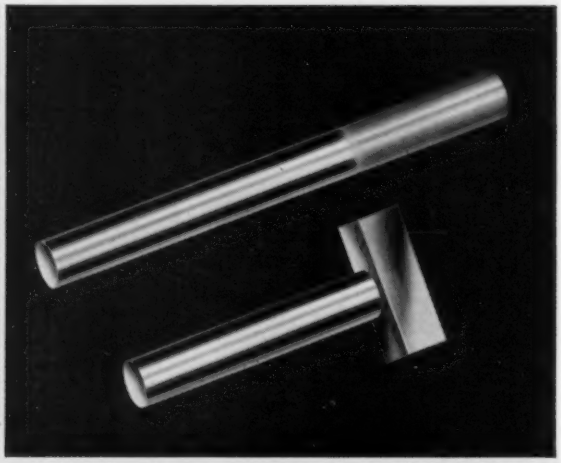
(Continued on page 35)

G.R.S. Cuts Costs 65%

with TOCCO* *Induction Heating*



Old Method—headpieces and shanks were butt-welded after shanks were pointed and both parts sandblasted.



New Method—relay cores are formed from barstock heated by TOCCO Induction Heating. No sandblasting or welding is required.

● When General Railway Signal Company converted from butt-welding to TOCCO Induction Heating to form this relay core, they not only produced a better product, faster—but saved money doing it.

Faster Production—A 75 kw, 10,000 cycle TOCCO unit heats 4⅜" of this 9⅞" long, ¾" diameter silicon steel bar to 2100° F. for upsetting magnetic relay cores. 40 kw of high-frequency energy is used, producing 250 pieces per hour—nearly three times the production achieved by their former method.

Lower Cost—Formerly G.R.S. cut separate shanks and rectangular headpieces for this relay core. The shanks had to be pointed and both pieces sandblasted prior to butt-welding. Heating the blanks for forging with TOCCO saves nearly two-thirds the cost of this former method.

TOCCO is Flexible—The part shown is only one of nearly 300 that G.R.S. is heating for forging with TOCCO. Production runs vary from 15 to over 50,000 pieces.

It may pay *you* to investigate TOCCO as a sound method of improving product quality, increasing production and reducing costs.

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today—NEW FREE Bulletin

The Ohio Crankshaft Co. • Dept:GG-7, Cleveland 5, Ohio

Please send copy of "Typical Results of TOCCO Induction Heating for Forming and Forging".

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Position_____

Company_____

Address_____

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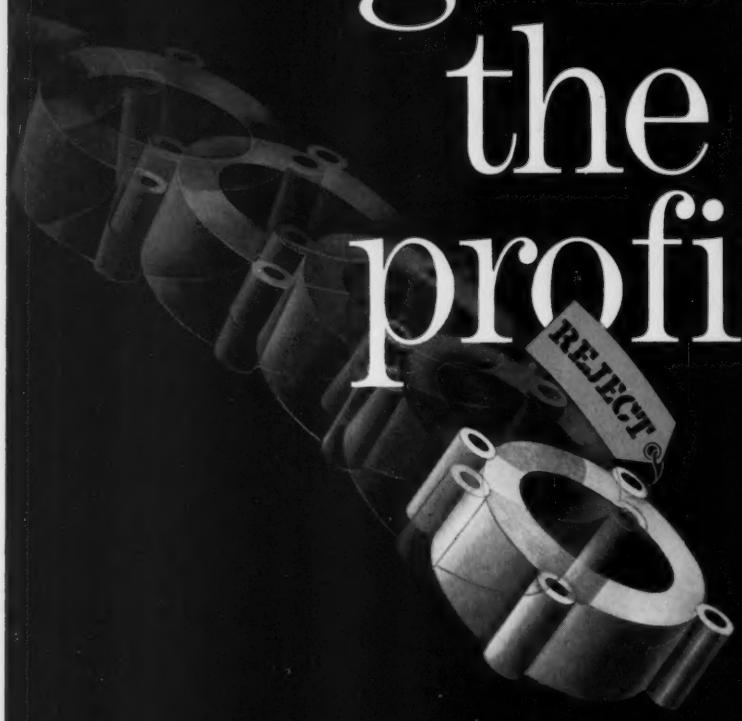
there goes the profit...



use of impure ammonia for metal treating is a frequent cause of discoloration on finished parts

The ammonia you use for metal treating can add to your profits—or reduce them! Impurities like oil or moisture may cause discolorations that land finished work in the salvage box. They are also a common cause of poisoned catalysts and other costly dissociator troubles.

Barrett Brand Anhydrous Ammonia, Refrigeration Grade, protects your profits and production schedules because it's at least 99.98% PURE, DRY ammonia. And each cylinder is double tested to make sure this high standard is maintained.

Barrett Brand Anhydrous Ammonia is stocked in 150, 100 or 50-lb. cylinders by distributors from coast to coast. Tank car or tank truck lots are available from Nitrogen Division's plants and bulk terminals at strategic locations.

Write for a list of Barrett Brand Anhydrous Ammonia distributors or for any technical assistance on the use of ammonia in metal treating.

Dept. CA 2-15-7

Allied Chemical — NITROGEN DIVISION

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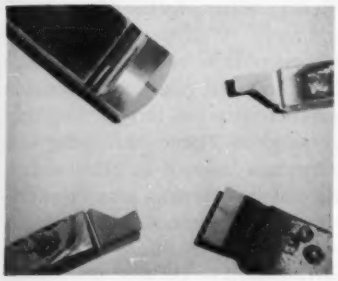
NEWS TO HEAT TREATERS

(Continued from page 30)

that is done with Vapor Blast Liquid Honing equipment.

Liquid Honing uses abrasive and hydraulic action to force fine sintered material out of minute cracks or fissures, which then become obvious defects during visual inspection. Because of heat and pressure in grinding, such fissures are normally sealed and hidden by the sintered material; they do not always appear during inspection by acid etching, magnetic particle inspection or fluorescent penetrant checking.



Other uses include such toolroom and production-line operations as surface finishing, cleaning, descaling and deburring.

For further information circle No. 11

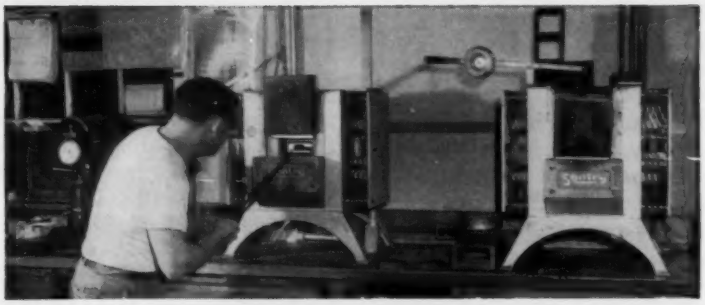
INDUSTRIAL LEATHER GLOVES

A new line of industrial gloves featuring a new leather with exceptional wearing qualities has been announced by the Wearhide Glove Company of Rockford, Michigan. Tests by independent testing laboratories indicate that this leather, known as Horsebutt Split Leather, gives up to three times as much wear as other work glove leathers. The manufacturer claims completely satisfactory results in dry cleaning tests of the gloves. In some cases this provides added savings.

The new line of gloves, sold through industrial distributors, only, includes three basic styles to meet the needs of most industrial applications. They are available in safety cuff, gauntlet and knit wrist patterns. All styles have canvas backs.

For further information circle No. 12

(Continued on page 36)



BAUSCH & LOMB Solves Metallurgical Problems with SENTRY Hardening

"The Sentry Diamond Block Atmosphere Makes the Difference"

Bausch & Lomb, famed manufacturer of optical and metallurgical equipment, has relied on Sentry high speed steel hardening furnaces for over 20 years. These furnaces regularly harden a broad range of tools and parts made from many types of steels and special alloys.

Bausch & Lomb has proved: The truly neutral atmosphere automatically produced by Sentry Diamond Blocks completely protects all types of high speed and high carbon high chrome steels from scale or decarburization during heat treatment.

Tools may be soaked to develop any predetermined characteristics without danger of surface deterioration.

Send us samples of your high speed tools for a free demonstration of Sentry hardening. You, too, will be impressed with Sentry quality.

Sentry ELECTRIC FURNACES

TRADEMARK

Request Catalog T-53 · Write THE SENTRY CO., FOXBORO, MASS.

(*Continued from page 19*)

rectly behind; either the workpiece or the flame head may move; (3) the spinning method wherein the workpiece is rotated while it is subjected to the heat from the flame head (single or multiple); the workpiece is then immersion quenched; and (4) the combination progressive-spinning method wherein the workpiece is rotated while being progressively heated by the flame head (usually multiple) and quenched. Equipment used for flame hardening ranges from a manually operated hand flame head (welder's torch) to custom built automatic types for the spinning and progressive spinning methods.

The depth of the hardening zone produced by flame hardening will vary from about 1/32" to ¼" or more, the depth being dependent upon the fuels used, the flame head design and time of heating.

Any ferrous alloy capable of being hardened by conventional heating and quenching can be flame hardened although AISI-SAE 1035 to 1053 steels are the most widely used. Alloy steels such as AISI SAE 4140H, 8640H and 4340H are also used when special properties not obtainable with the carbon steels are required. Gray and pearlitic malleable cast irons are also often flame hardened. Carburized parts are sometimes flame hardened in selective areas.

Typical applications of flame hardening include gears, rolls and machine ways, valve stems, push rods, cams and levers. Flame hardening is particularly advantageous on extremely large parts which would be difficult or uneconomical to harden by conventional methods. It is advantageous also in applications which require only a small area or extremity to be hard. Because of the localized heating, gears and other parts of intricate shape can be flame hardened without affecting materially the dimensional accuracy. The spinning method for example is widely used in the hardening of gear teeth without any necessity for further finishing operations. Flame hardening can sometimes be used in place of carburizing and savings may be effected when a plain carbon steel, flame hardened, is used to replace a carburized low carbon, alloy steel.

The Induction Hardening Process

Induction hardening is a process of quench hardening in which the heat is generated in the workpiece by electrical induction. In this process, high frequency alternating currents, ranging from 50 to 3,000,000 cycles per second, are passed through the inductor or work coil establishing a highly concentrated magnetic field within the coil. The magnetic field thus established induces heat in the workpiece and upon attainment of the proper temperature and depth of heating the workpiece is quench hardened. From the standpoint of surface hardening, the useful frequency range is from 1000 to 3,000,000 cycles per second. The actual depth of heating by induction is a function of time, power density and frequency.

There are three types of induction heating equipment available commercially, each capable of producing different depths of hardening although some overlapping exists in their capabilities. For example, motor-generator equip-

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built to last and last!

General Alloys' Radiant Tube Assemblies combine castings and fabrications to obtain the best features of each for optimum performance and service life.

The cast return bends give uniformity and extra strength at the area usually susceptible to early failure. The fabricated straight sections are light weight and provide maximum efficiency for heat transfer.

Special design combines casting and fabrication for maximum service life and efficiency

General Alloys combination cast and fabricated Radiant Tube Assemblies are available in many types of heat and corrosion resistant alloys, in a wide range of shapes and sizes to meet your specific requirements.

Extensive experience in high alloy castings and fabrications, together with modern production and testing facilities, is your assurance of superior results and satisfaction.

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Specialists in high alloy castings and fabrications for 37 years

ment with frequency ratings from 1000 to 10,000 cycles can be used to harden workpieces from about 7/16" to over 4" diameter to depths ranging from 0.050 to 0.200". Spark-gap equipment having a frequency range of 20,000 to 600,000 cycles per second can be used to harden workpieces from ¼" to 2" diameter to depths ranging from 0.015 to 0.200". Electronic tube equipment having a frequency range of over 200,000 cycles exhibits the same capabilities as the spark-gap equipment; however, case depths of less than 0.015" require frequencies of over 1,000,000 cycles which can only be produced by electronic tube equipment.

Workpieces are hardened by induction principally by the following methods: (1) stationary; wherein neither the work or the inductor coil move while the surface is heated to the appropriate hardening temperature and then quenched by immersion nor by a spray issuing through the induction coil itself; (2) vertical or horizontal scanning wherein the workpiece is progressively heated by the inductor coil and progressively quenched by a separate or integrated spray quench ring. Rotating the workpiece while it is being heated promotes uniformity of depth of heating and quenching. Movement of workpieces in and out of the inductor coil or block can be mechanized and the entire operation made more or less automatic.

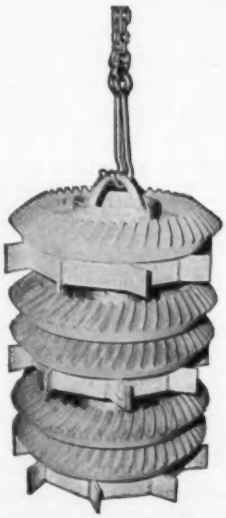
Materials used for induction hardening applications are similar to those described in the section on flame hardening. Since the maximum hardness attainable with a given steel is governed by its carbon content, the material used must contain the minimum carbon content which will produce the desired hardness. For example if 55 Rockwell "C" hardness is derised after induction hardening, the carbon content must be 0.40% minimum. Hardnesses of 58 and 60 Rockwell "C" minimum require carbon contents of 0.45 and 0.50% minimum respectively.

ROLOCK

FABRICATED ALLOYS

HEAT AND CORROSION RESISTANT

ROLOCK knows how to step up PIT-TYPE FURNACE EFFICIENCY



This BIG welded-fabricated fixture for processing heavy duty ring gears 28" in diameter is just an example of many hundreds of lift post fixtures built for use in pit-type furnaces. This fixture is held to 1670° F. for 12 hours in carburizing, then cooled to 1450° F. for 4 hours, then slowly air-cooled. It takes the place of a heavy casting.

Not only is this design relatively light in weight and hence economical in furnace time and fuel consumption, but it has proved exceptionally stable under the heavy load.

Rolock has become a major fabricator of a full range of pit-type furnace equipment adapted to the service requirements of all leading furnace makes . . . simply because Rolock designs and welded-fabrication know-how consistently reduce costs and help step up efficiency. Send us your next inquiry for recommendations and quote.

ROLOCK Pit-Type Furnace Equipment *includes:*

RETORTS
All sizes and for all makes of furnaces; incorporating ROLOCK's time-tested quality methods of fabrication.

BASKETS
A wide range of standardized or special designs, including ROLOCK's new high efficiency "corrugated" construction.

GRIDS and SCREENS
Screens available immediately from stock in a range of standard sizes and mesh. Also ROLOCK's new pressure-welded, truss-type grids.

FIXTURES
Often a special fixture will effect tremendous savings in handling parts. Let ROLOCK experience and facilities help you enjoy these economies.

SALES & SERVICE FROM COAST TO COAST
ROLOCK INC., 1232 KINGS HIGHWAY, FAIRFIELD, CONNECTICUT

JOB-ENGINEERED for better work
Easier Operation, Lower Cost

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APPRENTICE CORNER

(Continued from page 35)

The types of parts and workpieces which can be surface hardened by induction are literally countless. Gears (teeth), shafts, cams, crankshafts, cylinders, levers are but a few examples. The principal advantages of induction hardening parallel closely those of flame hardening. However, the cost of induction hardening equipment being substantially greater than that used for flame hardening more or less dictates its use for items which are produced in large quantities. Surface hardening by induction provides a high degree of control, flexibility and reproducibility. The wide range of frequencies produced by the different types of equipment make possible control of depth and contour of the hardened zone. Depth of hardening can be varied from about 0.015" to 0.200" or more and gear teeth and other irregular surfaces such as cams can be contour hardened. Internal surfaces are often hardened by induction. In recent years, surface hardening by induction has been integrated on machine tools as one of the operations amidst other machining operations. The equipment is readily adaptable to integration in the machine tool production line.

Some steels of low hardenability, such as the medium carbon variety, e.g. AISI-SAE 1040 or 1045, when heated throughout and quenched all over or time-quenched in certain sizes, harden to relatively shallow depths. The resultant properties are somewhat characteristic of steels surface hardened by flame or induction, at least to the extent of exhibiting a zone of high hardness at the surface and a core of lower hardness and greater ductility. Since this method of surface hardening involves heating and quenching the entire workpiece, distortion will be greater than that experienced when a part is heated and hardened selectively by flame or induction. Surface hardening can also be accomplished by selectively quenching a shallow hardening steel. In this method the workpiece is heated all over and only the area required hard is quenched by spray or immersion methods. The depth of the hardened zone will be governed by the hardenability and the mass of the steel.

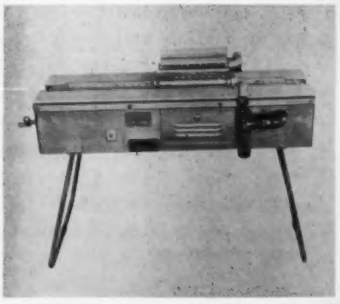
The foregoing describes surface hardening by selective heating and/or selective quenching in which the depth of hardening is governed by (1) the depth of heating; (2) the method of quenching and (3) the hardenability of the material. The degree of hardness is governed by the carbon content of the material. ■ ■ ■

NEWS TO HEAT TREATERS

(Continued from page 33)

MULTIFLAME BRAZER

Shown here is a Multiflame Brazing Machine, manufactured by Youngberg Brothers of Meriden, Connecticut. A modification of earlier, larger models, the #20-2 is the first YB semi-automatic brazing and soft-soldering machine to be offered at a price below $1,000. The #20-2 can also be used for tempering, annealing and hardening. The unit can be fitted into any production line. It is only 60" long, 24" wide and 34" high. It operates on manufactured, natural or LP gas, with conventional shop airlines supplying air pressure. Simple to install, set up and maintain, it requires only semi-skilled operators. Uses standard flux and preform solder forms. A regulated conveyor belt establishes production speeds.



For further information circle No. 13

■ ■ ■

LETTERS TO THE EDITOR

Dear Editor:

I appreciate your METAL TREATING immensely as a reader, but I prefer to be your subscriber. Please forward me your next publication. I know for a fact that it covers everything I need to know on heat treating.

ARTHUR D. TOY
Heat Treater
San Francisco Naval Shipyard
San Francisco, Calif.

Dear Editor:

I would be pleased to be placed on the mailing list for your excellent publication METAL TREATING.

Also, a copy of "Heat Treatment of Titanium" appearing in the March-April issue would be greatly appreciated.

JOHN M. VASELIN
Metallurgist
Bendix Products Division
Bendix Aviation Corp.
South Bend, Ind.

Gentlemen:

I have found your magazine to be very interesting and informative and would like to know how I may subscribe to it.

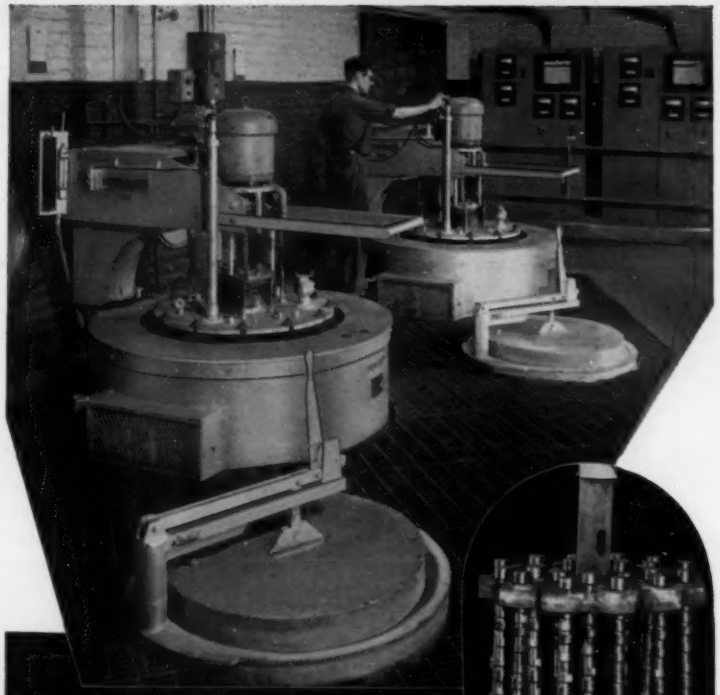
TRACY W. PECK
Heat Treat Manager
Caterpillar Tractor Co.
Peoria, Ill.

Dear Editor:

Please send, to the attention of the writer, complete information concerning the receipt of your magazine METAL TREATING.

We have read an old issue and believe it would be of great advantage to us to receive this magazine regularly.

ROBERT A. STALNAKER
Supervisor Materials Laboratory
Robertshaw Thermostat Division
Robertshaw-Fulton Controls Co.
Youngwood, Pa.



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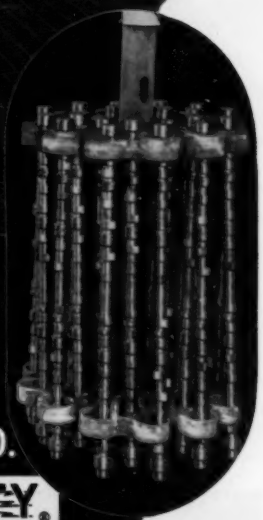
IMPROVED
at
WAUKESHA MOTOR CO.
with HEVI-DUTY®
VERTICAL RETORT
FURNACES



Cam shafts in furnace fixture ready for carburizing

When Waukesha Motor Company planned their own heat-treating department to carburize cam shafts, they chose Hevi-Duty Vertical Retort Furnaces because:

1. Positive pressure within the retort assures entrance of only the carburizing medium and the carrier gas. By simple regulation, conditions within the retort can be easily duplicated, assuring uniform results from heat to heat.

2. Multiple zone control assures even temperature from top to bottom of the load to produce uniform case.

3. Forced circulation assures penetration of atmosphere in the densest of loads.

4. Time and temperature control is accurate, assuring the desired case depth and carbon concentration.

5. Versatility of this furnace allows its use for other heat-treating operations, such as nitriding, hardening and annealing.

Bulletin 646 describes other advantages of Hevi-Duty Vertical Retort Furnaces. Write for your copy today.

HEVI DUTY ELECTRIC COMPANY
MILWAUKEE 1, WISCONSIN
Heat Treating Furnaces... Electric Exclusively
Dry Type Transformers *Constant Current Regulators*

MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

INTEGRATED HEAT TREAT SYSTEM

The Eclipse Fuel Engineering Company, Rockford, Ill., is offering five new bulletins giving complete details and specifications concerning their "Clean-Line" completely integrated, automatic, controlled atmosphere heat treating system.

The specification and data sheets describe and illustrate the combination of units designed for automatic heat treating operations such as hardening, carburizing, carbonitriding, carbon restoration and other operations. The bulletins describe an automatic heat treat unit; a tempering unit with cooling chamber; a controlled atmosphere draw furnace; an endothermic gas generator; and an immersion heated washer unit.

For further information circle No. 14

DUCTILITY TESTING

Steel City Testing Machines, Inc. of Detroit, have recently published a new bulletin describing their Model D Ductility Testing Machine.

Users of thin gauges of sheet metal will find this new bulletin interesting, as well as informative. It describes a simple, quick, and economical method of determining the ductility of their material before drawing.

For further information circle No. 15

HEAT TREATING ACCESSORIES

A new bulletin has been issued by the Aluminum and Architectural Metals Company, Detroit, Michigan, illustrating their complete line of heat treating and industrial processing accessories.

The folder illustrates the fabricated alloy steel items manufactured by them to customers' drawings and specifications for various heat treating operations and industrial processing.

The company maintains that they will cooperate with your engineers in designing metal fabrications for the specific requirements of the heat treating industry.

For further information circle No. 16

QUENCHING BY PROPELLER AGITATION

The United States Steel Corporation, Pittsburgh, Pennsylvania, has published a 28-page illustrated booklet entitled "Improved Quenching of Steel by Propeller Agitation" as part of its effort to develop higher quality steel products by improving heat treating practices.

By means of charts, drawings, and schematic diagrams and a clearly-written text, this technical booklet describes in detail the basic facts about propeller agitation of quenching media and claims that substantial savings and optimum heat treating performance are possible by this method.

For further information circle No. 17

ANHYDROUS AMMONIA

The Nitrogen Division of Allied Chemical and Dye Corporation,

'PSC' RADIANT TUBES in
Any Design or Dimension
Send for PSC Heat-Treat Catalog 54
PSC fabricated tubes furnish four substantial advantages: (1) Light-wall construction saves furnace time and fuel. (2) Return bends are of same wall thickness as tubes, promoting uniform flow of gas. (3) Smooth dense walls minimize carbon build-up and burn-out. (4) Up to 100% longer life. In any alloy, size or type, including parabolics. Also sheet-alloy heat-treating retorts and covers, boxes, baskets, fixtures, tubes, etc.
PSC
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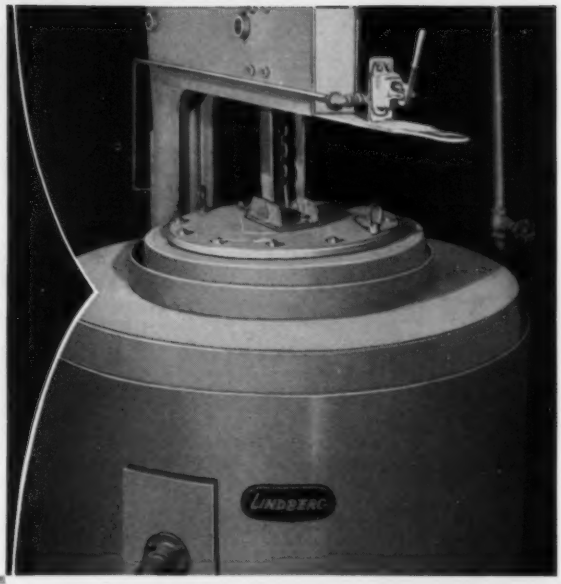
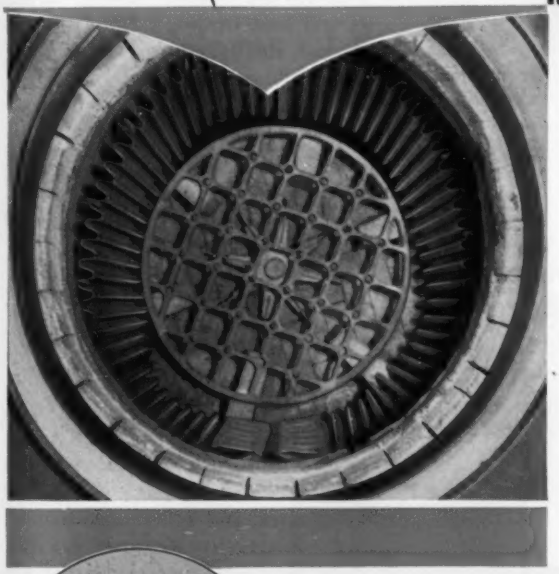
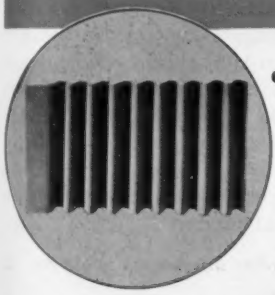
FROM THE OUTSIDE

. . . JUST ANOTHER LINDBERG PIT-TYPE CARBURIZING FURNACE

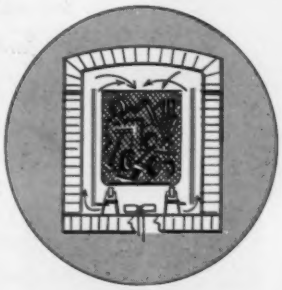


BUT LOOK INSIDE





CORRTHERM elements operate on extremely low voltage. No leakage through carbon saturation. Shock or short hazards eliminated. No complicated mountings required. An exclusive Lindberg development.



Note how CORRTHERM elements serve as baffles to direct forced convection streams through the charge.

No Retort!

Because it needs no retort, this new Lindberg electric vertical pit-type furnace gives you these important advantages:

- **Lower initial cost, no retort to pay for.**
- **No expensive retort replacement.**
- **Downtime for retort replacement eliminated.**
- **Increased production because it heats faster.**
- **Exact atmosphere control maintains work quality.**
- **Versatile, carbon-diffusing and requenching along with carburizing. Adaptable to variety of work.**

All this is made possible by Lindberg's new CORRTHERM electric heating element. For lower initial cost, lower maintenance costs, faster production, better quality control, why not look into this furnace. It's additional evidence that, if you're concerned with the application of heat to industry, better talk it over with Lindberg.

LINDBERG
ENGINEERING COMPANY

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Los Angeles Plant: 11937 S. Regentview Ave., at Downey, Calif.
Toronto Plant: EFCO-Lindberg, Ltd., 11 Front Street, East

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Write today for the free complete-line catalog . . . or outline your own special low-temperature requirements for a no-obligation survey.

SUNDSTRAND

Cincinnati Sub-Zero Products

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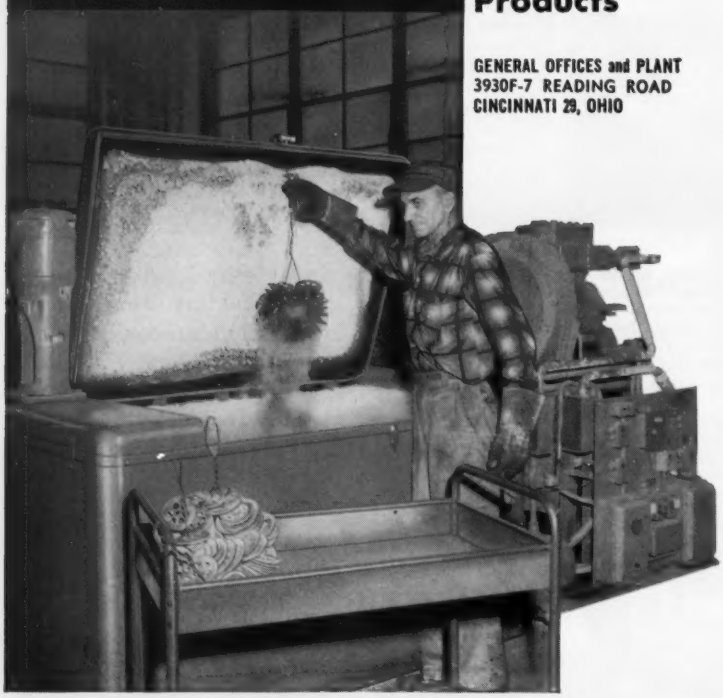

New York City, has published a useful bulletin entitled "Guide of the Use of Anhydrous Ammonia in Cylinders."

This 24-page illustrated booklet explains the chemical and physical properties of anhydrous ammonia with charts and diagrams showing its properties at different temperatures, and then describes its various uses and applications with instructions for its handling.

For further information circle No. 18

INDUSTRIAL OVENS AND DRYERS

A 16-page booklet issued by Young Brothers Company, Cleveland, Ohio, illustrates and describes their complete line of industrial ovens for baking, drying, curing, and heat treating. For easy reference, the bulletin contains sections describing batch type ovens, conveyor type ovens, various air recirculating and heating systems available, and control and safety equipment.

For further information circle No. 19

LABORATORY RESEARCH

A new 24-page bulletin, "An Approach to Interpretive Research," describes the laboratory facilities of the Selas Corporation of America, Dresher, Pennsylvania, which are available for Contract Research to private companies as well as to trade organizations, government agencies, and other organizations.

"Interpretive Research" describes investigations that bridge the gap between basic theory and practical application, applying the latest scientific knowledge and technique to the day-by-day needs of industry to improve existing materials, to develop new processes, and to create new end products.

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HEAT TREATING EQUIPMENT

A condensed 12-page catalog now being offered by the Pacific Scientific Company, Los Angeles, Calif., stresses advanced design heat treating equipment for every need.

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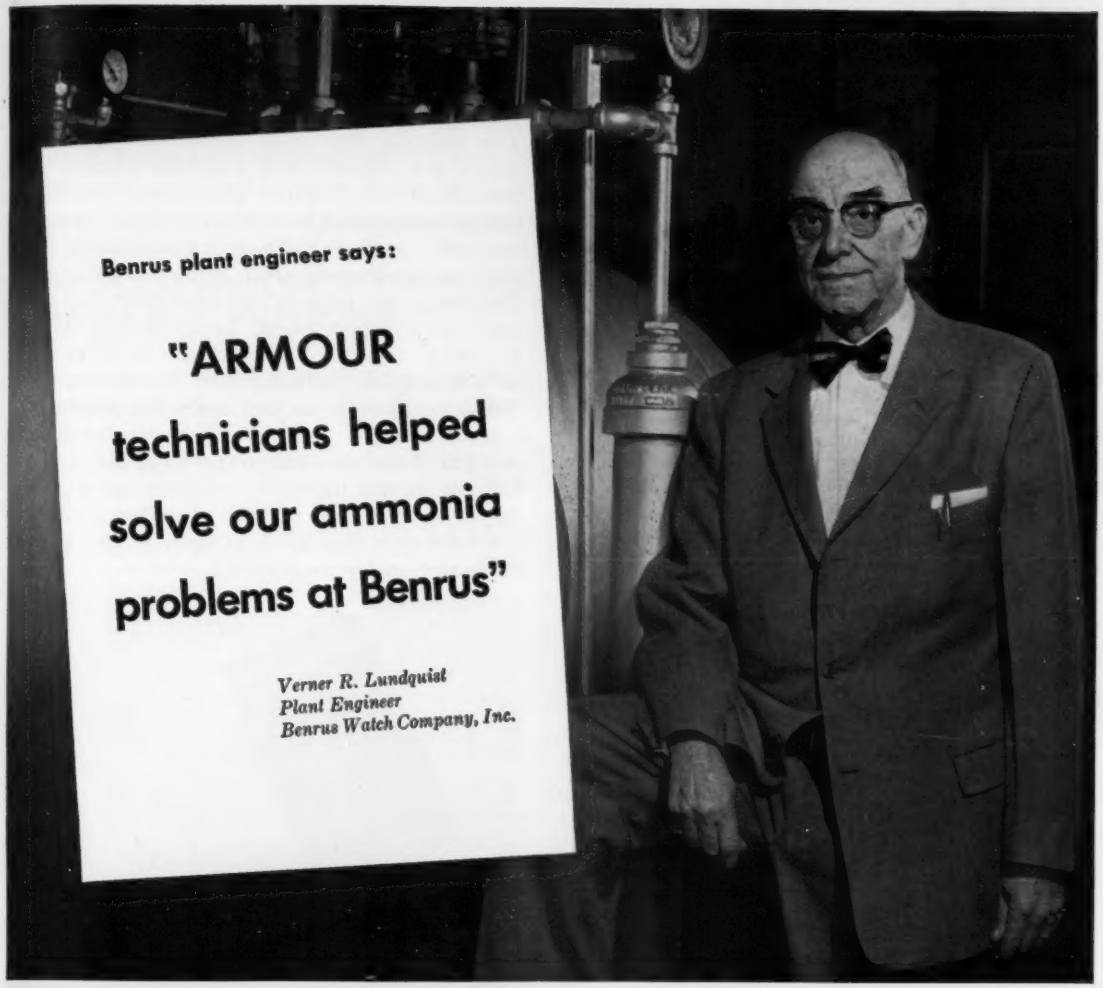
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STEEL GRIT ABRASIVE

(*Continued from page 8*)

unloads them as they exit.

Commercial Steel made its abrasive investigation with one of the five-cubic-foot tumble-blast machines. The company first made performance tests with chilled iron abrasives they had been accustomed to using. Size G-50 chilled iron grit was used. Subsequent testing was done with carbide-free steel grit. Although steel grit has high hardness for penetrating tough scales, its metallurgical structure can resist breakdown. This means the particles can keep their size, shape, mass, and usefulness longer. Tests with steel abrasive, as a result, showed a reduction of as much as 73.8% in consumption. Wheelabrator Corporation's size GH-50 Steeletts grit was used in this test period.

Maintenance savings were also experienced with steel grit. These also stem from the fact that steel grit particles are heat treated for toughness and so do not chip away upon impact. Sharp edges that cause excessive wear on a blast cleaning machine are therefore eliminated, and wear is greatly reduced.

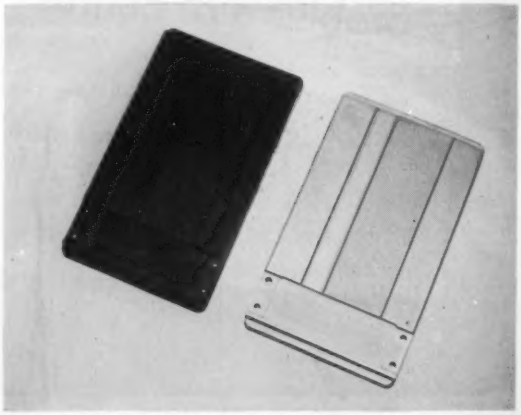

Fig. 3—These bases for tool room precision instruments are cleaned on a table-type blast cleaner, and are shown before and after blasting. (Courtesy of Wheelabrator Corp.)

Reduced abrasive breakdown also reduced required maintenance with respect to the blast cleaner dust control system. There was less dust in the form of useless, broken-down abrasive particles to collect. This meant less handling of collected dust and less frequent need for scavenger service to dispose of it. Less dust handled by the dust control system made less wear on the system itself.

Ventilation of the blast cleaning chamber and the abrasive reclaimer in each machine could be increased when using steel grit. Scale removal from the abrasive being reclaimed and reused was therefore much more efficient. This is important because scale that contaminates the blasting abrasive decreases cleaning efficiency. It slows cleaning down. Ventilation formerly had to be kept lower, however, because the iron abrasive broke down so rapidly into small particles. Higher ventilation then would have removed not only scale from the machines, but also small abrasive particles. ■■■

ABSTRACTS

(Continued from page 12)

The liquid salt nitriding procedure developed for hardening high speed steels is used in nitriding stainless steels. A proprietary salt composed of a mixture of carbonates and cyanides serves as the nitriding medium. Only degreasing and buffing are required to prepare the steel surfaces for nitriding. However, an adherent nickel coating 0.001 in. thick is needed to mask areas where nitriding is not desired.

Nitriding is performed by suspending the materials in the unagitated bath. After nitriding, the parts are air quenched and rinsed in water to remove the salt. ■ ■ ■

HEAT TREATING HINTS

(Continued from page 14)

nous martensitic structure. This size increase sets up internal transformation stresses in the steel. These inevitable stresses, when combined with the thermal stresses introduced by the cooling operation itself, can under adverse circumstances cause warping or even cracking of the steel. Utilizing less drastic quenching mediums by the selection of a higher alloyed steel holds these quenching stresses to a minimum, and an air hardening steel is less prone to exhibit these quenching problems than is a steel requiring a more drastic quench, such as oil or water.

Because of the relatively high alloy content of most tool steel compositions, rarely are quenching difficulties encountered from not maintaining the necessary critical quenching speed. Instead, one of the common quenching faults occurs as a result of not permitting the steel to cool to a sufficiently low temperature to permit the completion of the hardening reaction. This results in incomplete hardening and highly stressed finished parts. Tool steels should always be cooled down to a temperature where the parts can be handled comfortably with the bare hands prior to beginning the tempering operation.

During the quenching cycle, the steel is in its most highly stressed condition and therefore this step in the heat treating cycle generally introduces some of the greatest problems associated with the hardening process. Considerable skill and judgment are required in order to carry out this phase of the operation successfully. Each tool or die must be considered individually and each presents its own particular challenge to the heat treater.

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ANNEALING DIE CASTINGS

(*Continued from page 6*)

splashing on the surface of the die and solidifying before the main flow of metal arrives. These spots sometimes drop out during buffing. At other times they are pulled loose by the tension of the plated metal.

Blisters

Blisters usually arise from entrapped gas near the surface of the casting. They may come from the die fully developed or develop after plating. This type of blister can be easily distinguished from the typical plating blister inasmuch as it is quite hard, small, and spherical, whereas the plating blister, in the thin decorative plates, is springy and of any size and shape.

This type of casting defect has been attributed to too high temperature of the die during casting, resulting in metal "flutter".

Problem

The author was associated with a large manufacturer of automotive accessories for seven years as a plating and chemical engineer. During that time he encountered the above-mentioned defects intermittently. One particular instance stands out, both for persistence and the unorthodox method of correction used. The part was a zinc die casting weighing approximately one pound and was a combination of thin and heavy sections and deep recesses. The design was such that a cold shot appeared on one side of 95 per cent of the parts. Normal polishing and buffing only partially obliterated the defect. Deeper polishing on different abrasive belts only served to spread the cold shotted effect over a wider area. In spite of various finishing methods tried, in spite of .0006" of bright copper electroplate and .0005"-.0007" of bright nickel electroplate, it was necessary to hand buff 48 per cent of the parts after nickel plating to achieve the desired finish. Since the production of this part averaged 90,000 pieces per month the problem was worthy of vigorous attack. Needless to say every "trick in the book" and many more that were not were tried in the plating department with no noticeable improvement. It was then that the plating room foreman, the resident inspector, and the author decided to try an unorthodox, and by most die casters, a heretical approach.

We reasoned that if the surface metal could be flowed more easily during buffing, it might be possible to compact the cold shot area sufficiently to obtain a smooth plating surface.

Treatment

Knowing that the chilling effect of the die gave rise to a smaller grain size and a higher hardness at the surface, we reasoned that to heat the casting to approximately the original die temperature should cause

some change in surface hardness. The first castings were heated to 375°F. for one hour and air cooled. The castings were noticeably softer and gave a duller sound when tapped. However, buffing results were much improved and plated test castings had a much better finish. A large production run was made at the 375°F. temperature. It was found that hand buffing, after nickel plating, was reduced from 48 per cent to 33 per cent. Various temperatures, times, and water quenching were tried on test strips. Hardness checks and microexaminations were made.

It was found that an hour at a heat of 410°F.-425°F. gave the greatest average drop in hardness, 6 points on the Rockwell 15T scale. Original hardness averaged 15 T 77.5 and heat treated hardness 15 T 71. Water quenching resulted in a hardness only one point lower than the hardness obtained by air cooling and was not deemed necessary. Microexamination showed that the original casting had fine dendritic grain near the die surface and coarse widely spaced grain toward the center of the section. The heat treated sections exhibited a break-up of the dendritic structure and a more evenly dispersed grain showing a tendency to amphorous grain boundaries. The time of heating, over one hour, or the method of cooling had no discernible effect on the microstructure. The author had no access to equipment for taking photomicrographs at that time and no micrographs exist of those early samples. However, Fig. 1 and Fig. 2 show a similar change in microstructure by heat treating at 410°F. for one hour. Although the change in microstructure is not as pronounced as that obtained in the original work, the hardness drop is almost the same from Rockwell 15 T 77 to a 15 T 72.

Production Usage

Large production runs were made using a temperature of 410°F., one hour at temperature and air cool. The buffing of the raw casting was much improved. Hand buffing of nickel plated parts dropped to 13.5 per cent as compared to the original 48.2 per cent. The cost of buffing this 13 per cent plus the cost of heat treating 100 per cent of the parts was slightly less than one-half the cost of buffing the 48 per cent. Other dividends soon appeared. Every plater knows that "wet" nickel chrome plates easier, with less rejects, than buffed nickel. The actual figures are lost now, but the saving in buffed chrome and mis-plates was substantial. Salt spray resistance showed marked improvement. Non-heat treated castings and heat treated castings were plated through the same tanks at the same time and then placed in a standard salt spray cabinet. After a period of time, 72 per cent of the untreated castings had developed blisters and 38 per cent of the heat treated castings had developed blisters. The blisters on the heat treated castings were much smaller and fewer in number.

Precautions Recommended

The above results would lead one to believe that heat treating should be made an integral part of the finishing procedure. However, the problem must be approached with caution for the following reasons:

1. Some thin walled castings may warp during heat treatment and if the walls are thin enough, little or no gradation of grain size may be present.

2. Since the purpose of heat treating is to soften the surface, it may affect the overall strength of the part. The function of the part must be considered and some strength tests run on heat treated parts.

3. Handling of heat treated parts before and after buffing must not be rough, as the softer surface "dings" more easily. This should not be a great problem in a well run shop.

However, the author does believe that the heat treating of zinc die castings could very well be an excellent emergency procedure in many cases and even a standard procedure in a few cases.

It is hoped that some interested party will systematically investigate the long-range effect of corrosion resistance of both plated and unplated die castings after various types of heat treatment. ■ ■ ■

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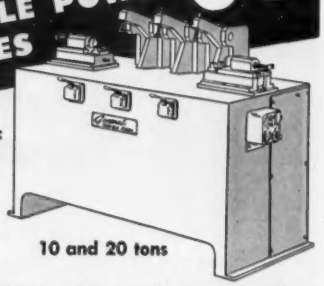

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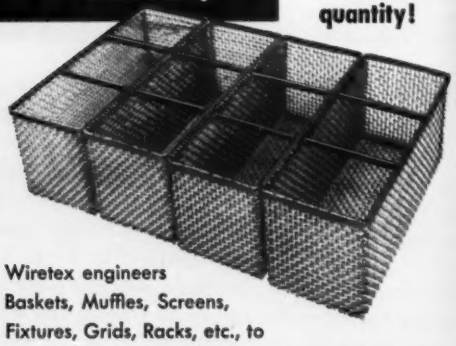

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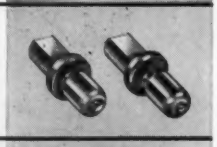

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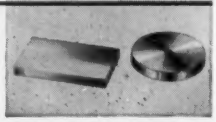

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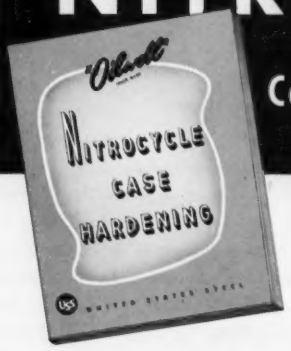

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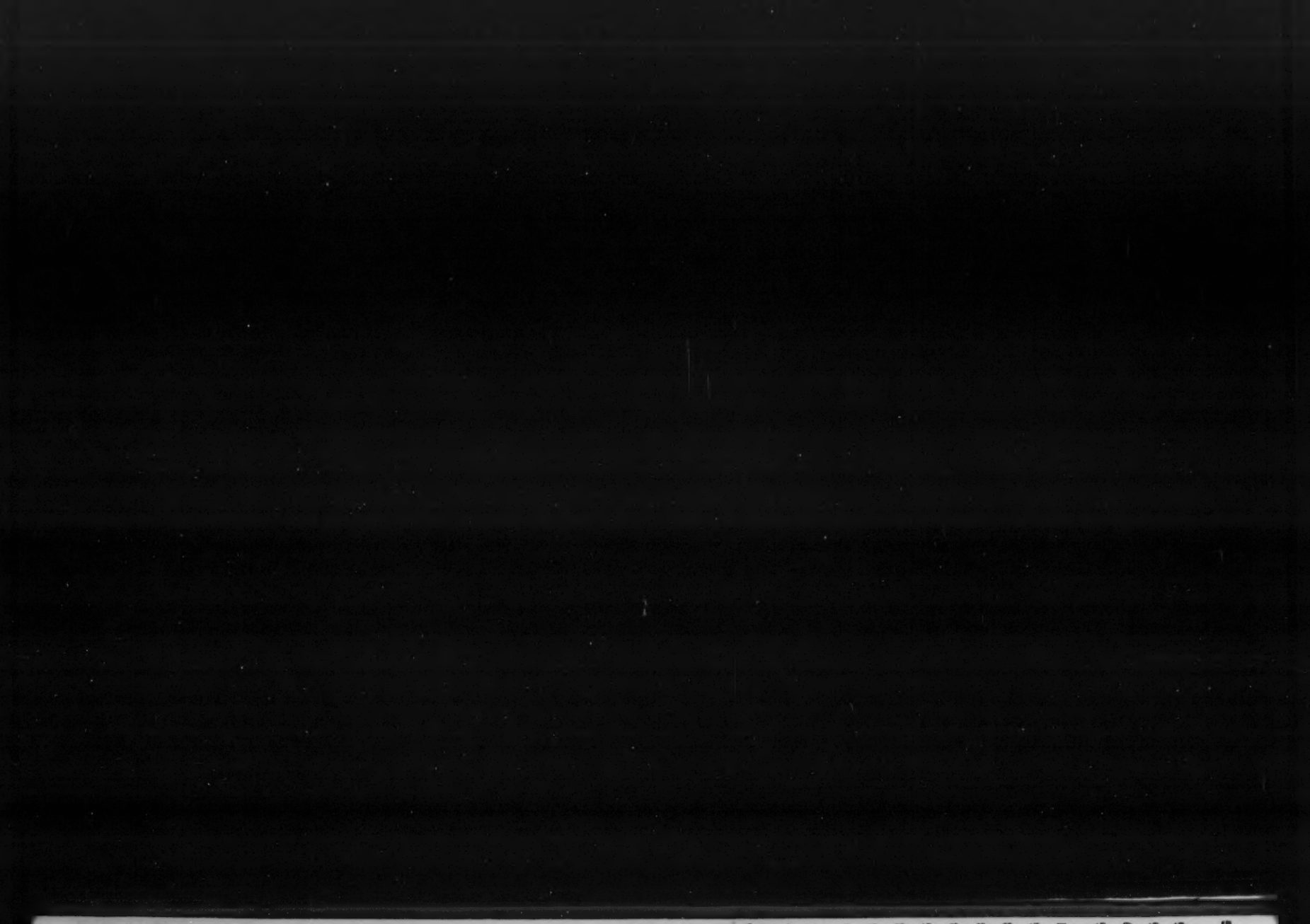
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